AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 4, No. 42. WEEKLY. | NEW YORK, OCTOBER 22, 1881. | $3.00 per Annum. SINGLE COPIES, 6 CENTS.

COPYRIGHT, 1881, BY AMERICAN MACHINIST PUBLISHING COMPANY.

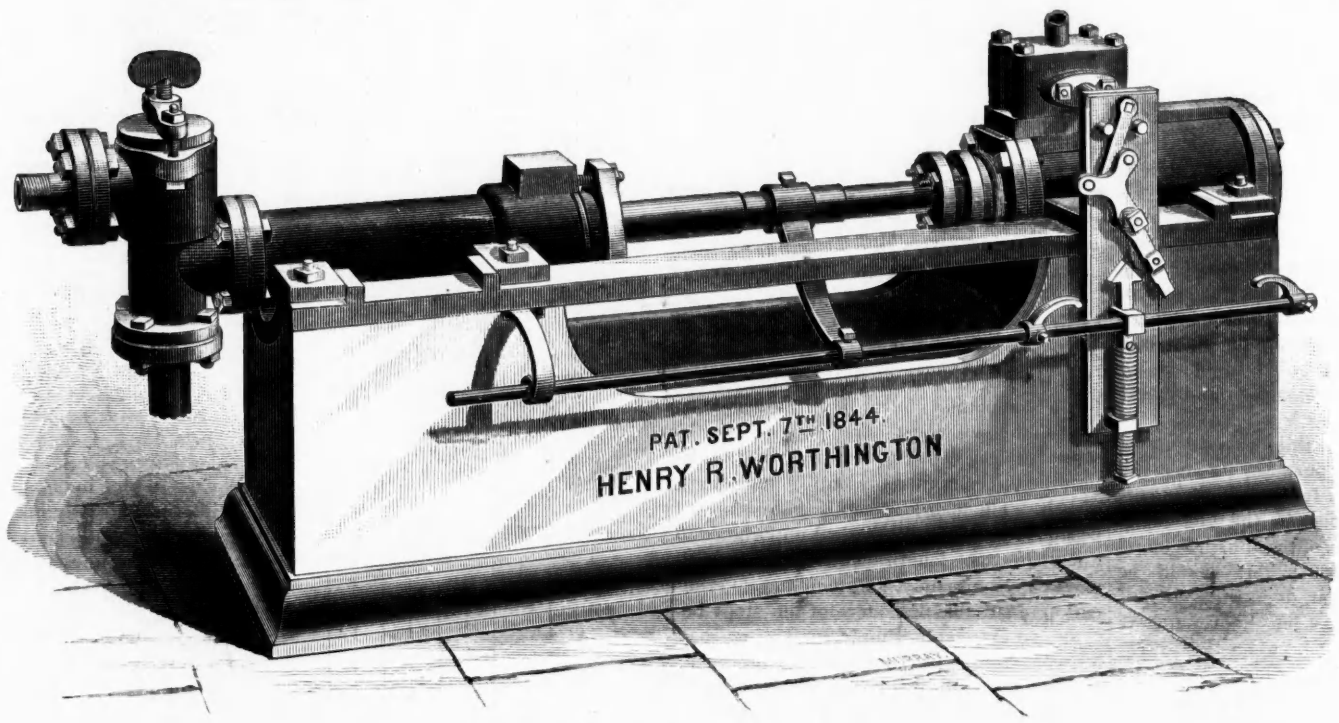
For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Worthington Steam Pump—As it Was and as it Is.

The engravings upon this page present a marked contrast in the manufacture of steam pumps. The old Worthington pump here represented was the first direct-acting steam pump ever made It was designed and used for feeding boilers. A patent was taken out Sept. 4, 1844, by Henry R. Worthington, who always styled this pump as "the old No. 1," when referring to it afterwards. It was a pump of the most simple form. The barrel was of cast iron having a plunger 1⅛" in diameter, which worked through a stuffing box packed with hemp. The valves were of the old-fashioned wing pattern with conical seats. There were two of these valves 2" in diameter, which had spiral springs of brass wire upon their backs. The feed was 1¼", and the discharge 1" pipe. The steam cylinder was 3½" in diameter, and 8" stroke. The frame was formed by two flat bars of iron to which the cylinder and pump were bolted. The valve was of the circular slide type, the diameter of the circle being 2", and the length of the valve 1¾". The valve was of composition, without lap, and the ports, of which there were three, were $\frac{3}{16}$" wide and ¾" long. The valve was operated by means of a collar upon the square end of the stem. This collar had a flange which fitted freely over each side of the valve and compelled it to move freely with the collar.

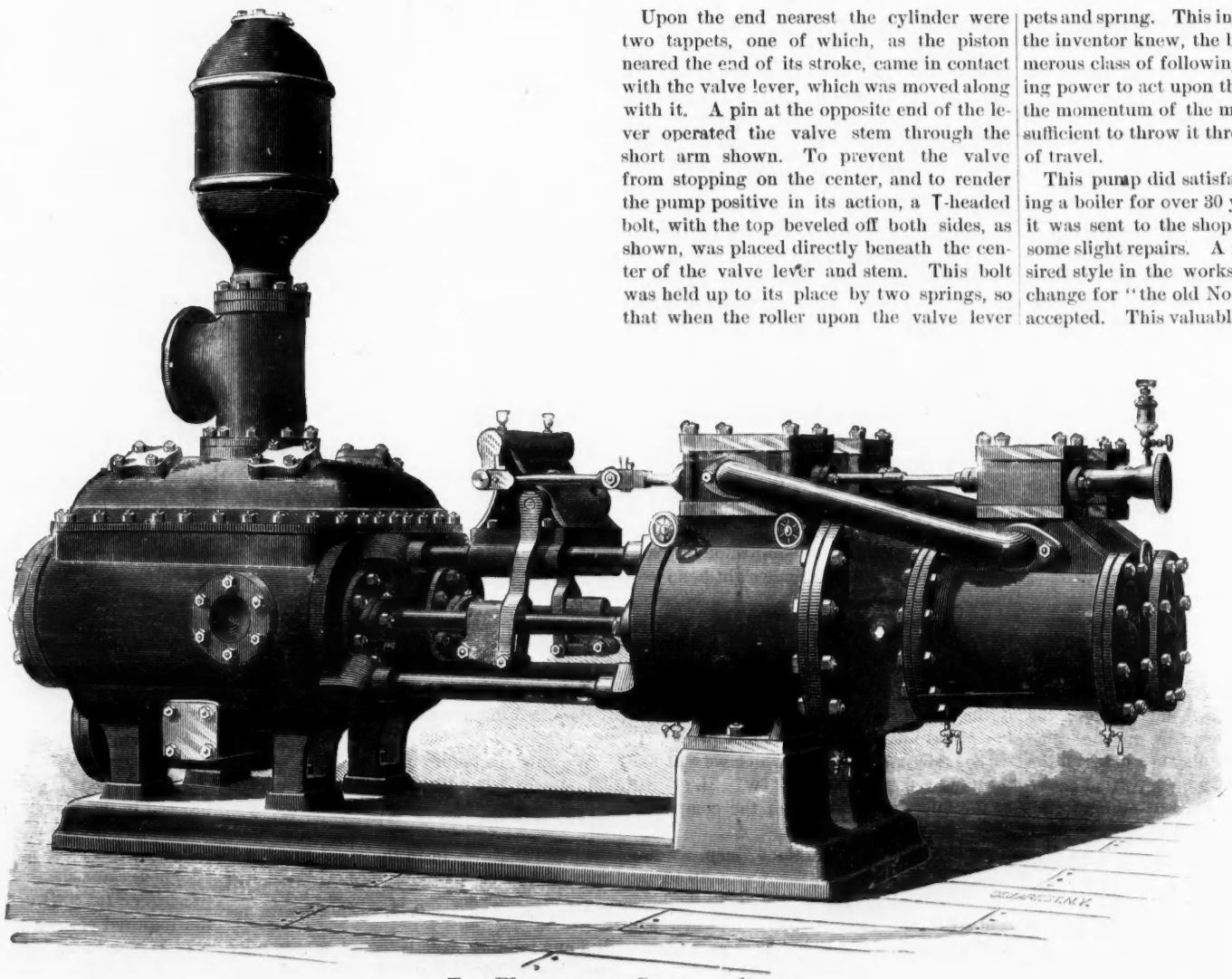
The valve stem was actuated by the following mechanism. An arm was attached to the piston by a set screw, while a rod passed through the other end, and was also held by a set screw. This rod was guided by steadyments at each end.



THE FIRST DIRECT-ACTING STEAM PUMP.

Upon the end nearest the cylinder were two tappets, one of which, as the piston neared the end of its stroke, came in contact with the valve lever, which was moved along with it. A pin at the opposite end of the lever operated the valve stem through the short arm shown. To prevent the valve from stopping on the center, and to render the pump positive in its action, a T-headed bolt, with the top beveled off both sides, as shown, was placed directly beneath the center of the valve lever and stem. This bolt was held up to its place by two springs, so that when the roller upon the valve lever was moved by the tappets just past the highest point of the bolt head, thus compressing the spring, the action of the spring would then throw the lever quickly over, and open the valve wide upon the opposite side. The momentum of the engine was insufficient for this purpose, and the valve was liable to stop in such a position as to cover both the steam ports. But by the application of the spring in the manner alluded to, the danger of stopping the valve in such a position as to prevent the motion of the engine was entirely obviated. The steam valve remained at rest, with the steam port wide open, until it was moved instantly to the opposite position by the combined action of the tappets and spring. This invention was, so far as the inventor knew, the beginning of that numerous class of following inventions for storing power to act upon the steam valve, when the momentum of the moving parts was insufficient to throw it through its full distance of travel.

This pump did satisfactory service in feeding a boiler for over 30 years, when, in 1874, it was sent to the shop of the inventor for some slight repairs. A new pump of any desired style in the works was offered in exchange for "the old No. 1," which offer was accepted. This valuable relic was on exhibition during the Centennial in Philadelphia, and worked fully as well as some of the most modern oumps.



THE WORTHINGTON COMPOUND PUMP.

The other engraving upon this page represents the Worthington compound steam pump. The dimensions are as follows: High-pressure cylinders 14" in diameter, low pressure 20"; pump 12" in diameter, and 15" stroke.

This pump is intended to use steam expansively in a way which cannot be done in the ordinary form.

(*Concluded on p. 7*)

Table for finding the EFFECTIVE diameters of the steps of Cone Pulleys, when the pulleys are connected by an open belt and are unlike. Each vertical column in the table corresponds to a given length of belt and the numbers in these columns are the required effective diameters of the steps when the centers of the pulleys are a Unit's distance apart.

LENGTH OF BELT WHEN THE CENTERS OF THE CONE PULLEYS ARE A UNIT'S DISTANCE APART

2.0942	2.2827	2.3770	2.4712	2.5655	2.6597	2.7540	2.8482	2.9425	3.0367	3.1310	3.2252	3.3195	3.4137	3.5080	3.6022	3.6965	3.7907	3.8850	3.9792	4.0735	4.1677	4.2620	4.3562	4.4504	4.5447	4.6389	4.7332	4.8274	4.9217	5.0159	5.1102	Assumed diameter of steps, divided by distance between the centers of Cone Pulleys.
1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
.0594	.1750	.2313	.2867	.3413	.3950	.4479	.5000	.5514	.6020	.6518	.7010	.7495	.7974	.8447	.8913	.9373	.9828	1.0277	1.0721	1.1159	1.1593	1.2021	1.2444	1.2861	1.3274	1.3682	1.4085	1.4484	1.4877	1.5266	1.5650	0.00
.03	1477	.2050	.2613	.3167	.3713	.4250	.4779	.5300	.5814	.6320	.6818	.7310	.7795	.8274	.8747	.9213	.9673	1.0128	1.0577	1.1021	1.1459	1.1893	1.2321	1.2744	1.3161	1.3574	1.3982	1.4385	1.4784	1.5177	1.5566	0.03
	.1194	.1777	.2350	.2913	.3467	.4013	.4550	.5079	.5600	.6114	.6620	.7118	.7610	.8095	.8574	.9047	.9513	.9973	1.0428	1.0877	1.1321	1.1759	1.2193	1.2621	1.3044	1.3461	1.3874	1.4282	1.4685	1.5084	1.5477	0.06
	.09	.1494	.2077	.2650	.3213	.3767	.4213	.4850	.5379	.5900	.6414	.6920	.7418	.7910	.8395	.8874	.9347	.9813	1.0273	1.0728	1.1177	1.1621	1.2059	1.2493	1.2921	1.3344	1.3761	1.4174	1.4582	1.4985	1.5384	0.09
	.0594	.12	.1794	.2377	.2950	.3513	.4067	.4613	.5150	.5679	.6200	.6714	.7220	.7718	.8210	.8695	.9174	.9647	1.0113	1.0573	1.1028	1.1477	1.1921	1.2359	1.2793	1.3221	1.3644	1.4061	1.4474	1.4882	1.5285	0.12
2.1885	.0275	.0894	.15	.2094	.2677	.3250	.3813	.4367	.4913	.5450	.5979	.6500	.7014	.7520	.8018	.8510	.8995	.9474	.9947	1.0413	1.0873	1.1328	1.1777	1.2221	1.2659	1.3093	1.3521	1.3944	1.4361	1.4774	1.5182	0.15
		.0575	.1194	.18	.2394	.2977	.3550	.4113	.4667	.5213	.5750	.6279	.6800	.7314	.7820	.8318	.8810	.9295	.9774	1.0247	1.0713	1.1173	1.1628	1.2077	1.2521	1.2959	1.3393	1.3821	1.4244	1.4661	1.5074	0.18
2		.0244	.0875	.1494	.21	.2694	.3277	.3850	.4413	.4967	.5513	.6050	.6579	.7100	.7614	.8120	.8618	.9110	.9595	1.0074	1.0547	1.1013	1.1473	1.1928	1.2377	1.2821	1.3259	1.3693	1.4121	1.4544	1.4961	0.21
			.0200	.0844	.1475	.2094	.27	.3294	.3877	.4450	.5013	.5567	.6113	.6650	.7179	.7700	.8214	.8720	.9218	.9710	1.0195	1.0674	1.1147	1.1613	1.2073	1.2528	1.2977	1.3421	1.3859	1.4293	1.4721	0.24
.1177				.0500	.1144	.1775	.2394	.30	.3594	.4177	.4750	.5313	.5867	.6413	.6950	.7479	.8000	.8514	.9020	.9518	1.0010	1.0495	1.0974	1.1447	1.1913	1.2373	1.2828	1.3277	1.3721	1.4159	1.4593	0.27
.0894				.0140	.0800	.1444	.2075	.2694	.33	.3894	.4477	.5050	.5613	.6167	.6713	.7250	.7779	.8300	.8814	.9320	.9818	1.0310	1.0795	1.1274	1.1747	1.2213	1.2673	1.3128	1.3577	1.4021	1.4459	0.30
.06					.0440	.1100	.1744	.2375	.2994	.36	.4194	.4777	.5350	.5913	.6467	.7013	.7550	.8079	.8600	.9114	.9620	1.0118	1.0610	1.1095	1.1574	1.2047	1.2513	1.2973	1.3428	1.3877	1.4321	0.33
.0294					.0064	.0740	.1400	.2044	.2675	.3294	.39	.4494	.5077	.5650	.6213	.6767	.7313	.7850	.8379	.8900	.9414	.9920	1.0418	1.0910	1.1395	1.1874	1.2347	1.2813	1.3273	1.3728	1.4177	0.36
						.0364	.1040	.1700	.2344	.2975	.3594	.42	.4794	.5377	.5950	.6513	.7067	.7613	.8150	.8679	.9200	.9714	1.0220	1.0718	1.1210	1.1695	1.2174	1.2647	1.3113	1.3573	1.4028	0.39
							.0664	.1340	.2000	.2644	.3275	.3894	.45	.5094	.5677	.6250	.6813	.7367	.7913	.8450	.8979	.9500	1.0014	1.0520	1.1018	1.1510	1.1995	1.2474	1.2947	1.3413	1.3873	0.42
							.0271	.0964	.1640	.2300	.2944	.3575	.4194	.48	.5394	.5977	.6550	.7113	.7667	.8213	.8750	.9279	.9800	1.0314	1.0820	1.1318	1.1810	1.2295	1.2774	1.3247	1.3713	0.45
								.0571	.1264	.1940	.2600	.3244	.3875	.4494	.51	.5694	.6277	.6850	.7413	.7967	.8513	.9050	.9579	1.0100	1.0614	1.1120	1.1618	1.2110	1.2595	1.3074	1.3547	0.48
								.0160	.0871	.1564	.2240	.2900	.3544	.4175	.4794	.54	.5994	.6577	.7150	.7713	.8267	.8813	.9350	.9879	1.0400	1.0914	1.1420	1.1918	1.2410	1.2895	1.3374	0.51
									.0460	.1171	.1864	.2540	.3200	.3844	.4475	.5094	.57	.6294	.6877	.7450	.8013	.8567	.9113	.9650	1.0179	1.0700	1.1214	1.1720	1.2218	1.2710	1.3195	0.54
									.0029	.0760	.1471	.2164	.2840	.3500	.4144	.4775	.5394	.60	.6594	.7177	.7750	.8313	.8867	.9413	.9950	1.0479	1.1000	1.1514	1.2020	1.2518	1.3010	0.57
										.0329	.1060	.1771	.2464	.3140	.3800	.4444	.5075	.5694	.63	.6894	.7477	.8050	.8613	.9167	.9713	1.0250	1.0779	1.1300	1.1814	1.2320	1.2818	0.60
											.0629	.1360	.2071	.2764	.3440	.4100	.4744	.5375	.5994	.66	.7194	.7777	.8350	.8913	.9467	1.0013	1.0550	1.1079	1.1600	1.2114	1.2620	0.63
											.0174	.0929	.1660	.2371	.3064	.3740	.4400	.5044	.5675	.6294	.69	.7494	.8077	.8650	.9213	.9767	1.0313	1.0850	1.1379	1.1900	1.2414	0.66
												.0474	.1229	.1960	.2671	.3364	.4040	.4700	.5344	.5975	.6594	.72	.7794	.8377	.8950	.9513	1.0067	1.0613	1.1150	1.1679	1.2200	0.69
													.0774	.1529	.2260	.2971	.3664	.4340	.5000	.5644	.6275	.6894	.75	.8094	.8677	.9250	.9813	1.0367	1.0913	1.1450	1.1979	0.72
													.0292	.1074	.1829	.2560	.3271	.3964	.4640	.5300	.5944	.6575	.7194	.88	.8394	.8977	.9550	1.0113	1.0667	1.1213	1.1750	0.75
														.0592	.1374	.2129	.2860	.3571	.4264	.4940	.5600	.6244	.6875	.7494	.81	.8694	.9277	.9850	1.0413	1.0967	1.1513	0.78
														.0081	.0892	.1674	.2429	.3160	.3871	.4564	.5240	.5900	.6544	.7175	.7794	.84	.8994	.9577	1.0150	1.0713	1.1267	0.81
															.0381	.1192	.1974	.2729	.3460	.4171	.4864	.5540	.6200	.6844	.7475	.8094	.87	.9294	.9877	1.0450	1.1013	0.84
																.0681	.1492	.2274	.3029	.3760	.4471	.5164	.5840	.6500	.7144	.7775	.8394	.90	.9594	1.0177	1.0750	0.87
																.0138	.0981	.1792	.2574	.3329	.4060	.4771	.5464	.6140	.6800	.7444	.8075	.8694	.93	.9894	1.0477	0.90
																	.0438	.1281	.2092	.2874	.3629	.4360	.5071	.5764	.6440	.7100	.7744	.8375	.8994	.96	1.0194	0.93
																		.0738	.1581	.2392	.3174	.3929	.4660	.5371	.6064	.6740	.7400	.8044	.8675	.9294	.99	0.96
																		.0157	.1038	.1881	.2692	.3474	.4229	.4960	.5671	.6364	.7040	.7700	.8344	.8975	.9594	0.99
																			.0457	.1338	.2181	.2992	.3774	.4529	.5260	.5971	.6664	.7340	.8000	.8644	.9275	1.02
																				.0757	.1638	.2481	.3292	.4074	.4829	.5560	.6271	.6964	.7640	.8300	.8944	1.05
																				.0131	.1057	.1938	.2781	.3592	.4374	.5129	.5860	.6571	.7264	.7940	.8600	1.08
																					.0431	.1357	.2238	.3081	.3892	.4674	.5429	.6160	.6871	.7564	.8240	1.11
																						.0731	.1657	.2538	.3381	.4192	.4974	.5729	.6460	.7171	.7864	1.14
																						.0050	.1031	.1957	.2838	.3681	.4492	.5274	.6029	.6760	.7471	1.17
																							.0350	.1331	.2257	.3138	.3981	.4792	.5574	.6329	.7060	1.20
																								.0650	.1631	.2557	.3438	.4281	.5092	.5874	.6629	1.23
																									.0950	.1931	.2857	.3738	.4581	.5392	.6174	1.26
																									.0200	.1250	.2231	.3157	.4038	.4881	.5692	1 29
																										.0500	.1550	.2531	.3457	.4338	.5181	1.32
																											.0800	.1850	.2831	.3757	.4638	1.35
																												.1100	.2150	.3131	.4057	1.38
																												.0255	.1400	.2450	.3431	1.41
																													.0555	.1700	.2750	1.44
																														.0855	.2000	1 47
																																1.50

Cone Pulley Diameters.

No. 2.

By J. F. KLEIN, D.E.,
Instructor in Dynamical Engineering, Sheffield Scientific School, Yale College.

Our preceding article on "Cone Pulley Diameters" considered only the case where the two cone pulleys were exactly alike. Now although this case occurs much more frequently than the case in which the cone pulleys are unlike, it is nevertheless true that unlike cone pulleys occur with sufficient frequency to make it desirable that convenient means be established for obtaining the diameters of their steps rapidly and accurately.

The accompanying table was calculated by the writer for this purpose; its accuracy is more than sufficient for the requirements of practice, the numbers in the table being correct to within a unit of the fourth decimal place (*i.e.*, within .0001). It should be noticed that the tabular quantities are not the diameters of the steps, but these diameters divided by the distance between the centers of the cone pulleys; in other words, the tabular quantities are the effective diameters of the steps only when the centers of the pulleys are a unit's distance apart. By thus expressing the tabular quantities in terms of the distance apart of the axis, the table becomes applicable to all cone pulleys whatever their distance from each other, the effective diameters of the steps being obtained by multiplying the proper tabular quantities by the distance between the centers of the pulleys.

Before describing and applying the table, we will call attention to the term "effective" diameter. The effective radius—as is well known—extends from the center of the pulley to the center of the belt; the effective diameter, being twice this effective radius, must also equal the actual diameter plus thickness of belt.

The table is so arranged that the diameter (divided by distance between centers) of one step of a belted pair will always be found in the extreme right-hand column; while its companion step will be found on the same horizontal line, and in that vertical column of the table corresponding to the length of belt employed. For example, if column 14 of the table corresponded to the length of belt employed, some of the possible pairs of diameters would be as follows:

.7118	.5813	.42	.2164	.0474
.06	.24	.42	.60	.72

The upper row of this series of pairs being taken from column 14, and the lower row from the extreme right-hand column, the numbers in each pair being on the same horizontal line. If the distance between the centers of the pulleys were 60″, the effective diameters of the steps corresponding to the above pairs would be:

42.71	34.88	25.2	12.98	2.84″
3.6	14.4	25.2	36.0	43.20

being obtained by multiplying the first series of pairs by 60; the length of belt, which would be equally tight on each of these pairs would be $3.3195 \times 60'' = 199.17''$.

To get the actual diameters of these steps when thickness of belt $= \frac{7}{32} = 0.22''$, we have simply to subtract 0.22″ from the effective diameters just given, thus:

42.49	34.66	24.98	12.76	2.62″
3.38	14.18	24.98	35.78	42.98

would be the series of pairs of actual diameters.

In solving problems relating to the diameters of cone pulleys by means of the accompanying table, we must have, besides the distance between centers, sufficient data to determine the column representing the length of belt. The length of belt is seldom known because it is of small practical importance to know its exact length; but it may be estimated approximately, and then the determination of suitable diameters of the steps becomes an extremely simple matter, as may be seen from what has already preceded. When the length of the belt is not known, and has not been assumed, we indirectly prescribe the length of belt by assuming the effective diameters of the two steps of a belted pair; thus, in the figure in the next column the length of belt is prescribed when the distance $A\ B$, and any one of the pairs of steps D_1d_1, D_2d_2, D_3d_3 and D_4d_4 are given. We will show in the following examples how the length of belt and its corresponding column of diameter may be found when a pair of steps (like D_1d_1), are given.

EXAMPLE 1. Given
the effective diameters 4.5, 9, 15, 21″ on cone A,
" " diameter — — 15″ — " B,
and the distance between centers equal to 50 inches.

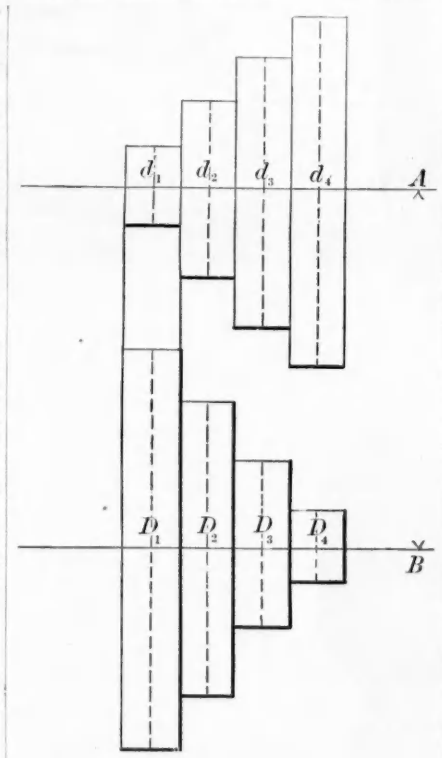
Required the remaining diameters on cone B.

Since in this example the steps of the given pair are equal, we look for $\frac{15}{50} = 0.30$, in the extreme right-hand column of table; we will find it in the 11th line from the top; now looking along this line for the diameter of the other step, $= \frac{15}{50} = 0.30$, we will find it in column 10; consequently the numbers of this column may be taken as the diameters of the steps which are the companions or partners of those in the extreme right-hand column.

We can now easily determine the remaining members of the pairs to which 4.5″, 9″, and 21″ steps respectively belong. To find the partner of the 4.5 step, we find $\frac{4.5}{50} = 0.09$ in the right-hand column, and look along the horizontal line on which 0.09 is placed, till we come to column 10, in which we will find the number 0.4850; $0.4850 \times 50'' = 24.25''$ will be the effective diameter of the companion to the 4.5″ step.

To find the partner to the 9″ step, we proceed as before, looking for $\frac{9}{50} = 0.18$ in the right-hand column, and then along the horizontal line of 0.18 to column 10, then will $0.4113 \times 50'' = 20.57''$ be the required companion to the 9″ step of cone A.

In like manner for the partner of the 21′



step we get $0.1700 \times 50'' = 8.5''$. The effective diameter therefore will be,

4.5″	9″	15″	21″	on cone A,
24.25	20.57	15″	8.5	" B.

If the thickness of belt employed were 0.25″ the *actual* diameters of steps would be,

4.25	8.75	14.75	20.75	on cone A,
24.00	20.32	14.75	8.25	" B,

and the length of belt would be $2.9425 \times 50 = 147.125''$.

EXAMPLE 2. Given the effective diameters

6″	12″	18″	24″	on cone A,
30″	—	—	—	" B,

and the distance between centers = 40″.

Required the unknown diameters on cone B.

We must, as before, first find the vertical column corresponding to the length of belt which joins the pair of steps $\frac{6''}{30''}$. We find the number $\frac{6}{40} = .15$ in the right hand column, and then look along its horizontal line for its partner $\frac{30}{40} = 0.75$. Since we do not find any number exactly equal to .7500, we must interpolate. For the benefit of those not familiar with the method of interpolation we will give in detail the method of finding intermediate columns of the table. On the aforesaid horizontal line we find in column 16 a number 0.7520, larger than the required 0.7500, and in column 15 a number 0.7014, smaller than 0.7500; evidently the intermediate column, containing the required 0.7500, must lie between columns 16 and 15. To find how far the required column is from column 16, we subtract as follows:

0.7520	0.7520
0.7500	0.7014
.0020	0.0506

then the fraction $\frac{.0020}{.00506} = 0.04$ nearly will represent the position of the required intermediate column; namely, that its distance from column 16 is about $\frac{4}{100}$ of the distance between the adjacent columns, 15 and 16.

To find other numbers in this intermediate column we have only to multiply the difference between the adjacent numbers of columns 16 and 15 by 0.04, and subtract the product from the number in column 16. But it is not necessary to find as many numbers of the intermediate columns as are contained in either of the adjacent columns; it is only necessary to find as many numbers as there are steps in each of the cone pulleys. We will now illustrate what has preceded, by finding the partner to the 12″ step of cone A. Find, as before, the horizontal line corresponding to $\frac{12}{40} = 0.30$, then take the difference between the numbers 0.6413 and 0.5867 of columns 16 and 15, and multiply this difference, 0.0546, by 0.04; this product = 0.0022 subtracted from 0.6413, will give 0.6391, a number of the intermediate columns corresponding to the length of belt of the present problem. Multiplying by the distance between the axes = 40″ we get $0.6391 \times 40 = 25.56$, for the diameter of the step of cone B which is partner to the 12″ step of cone A.

To find the companion to the 18″ step, we proceed in the same manner, looking for the horizontal line $\frac{18}{40} = 0.45$, and interpolating as follows:

$0.5094 - (0.5094 - 0.4500) \times 0.04 = 0.5070$.

Consequently, $0.5070 \times 40'' = 20.28''$ will be the required partner of the 18″ step.

In like manner, for the 24″ step, we have

$0.3500 - (0.3500 - 0.2840) \times 0.04 = 0.3474$, and

$0.3474 \times 40 = 13.90$.

The effective diameters are therefore

6″ 12″ 18″ 24″ on cone A.
30 25.56 20.28 13.9 " B.

The actual diameters, when thickness of belt = 0.20″, are:

5.8 11.8 17.8 23.8 on cone A.
29.8 25.36 20.08 13,7 " B.

And the length of belt will be:

$$[3.5080-(3.5080-3.4137)\times 0.04]\times 40''= 140.17''$$

Example 3.—Given the effective diameters:

12″ 18″ 24″ 30″ on cone A
33″ — — — " B

and the distance between the centers = 60″.

Required the remaining diameters on cone B.

The horizontal corresponding to $\frac{12}{60}=0.20$ lies $\frac{2}{3}$d way between the horizontal line, corresponding to 0.18 and 0.21; the number $\frac{33}{60}=0.5500$, corresponding to the companion of the 12″ step, will therefore lie $\frac{2}{3}$d way between the horizontal lines 0.18 and 0.21. We have now to find two numbers on this $\frac{2}{3}$d line, of which one will be less and the other greater than 0.5500. An inspection of the table will show that these greater and less numbers must lie in columns 13 and 12. The numbers on the $\frac{2}{3}$d line itself may now be found as follows:

In column 13, $0.5750-\frac{2}{3}(0.5750-0.5513)=0.5592$.

In column 12, $0.5213-\frac{2}{3}(0.5213-0.4967)=0.5049$.

0.5592 will be the number on the $\frac{2}{3}$d line, which is greater than 0.5500, and 0.5049 will be the one which is less than 0.5500. The position of the intermediate column, corresponding to the length of belt of the present example, may now be found, as before, briefly. It is:

$$\begin{matrix}0.5592-0.5500=0.0092\\ 0.5592-0.5049=0.0543\end{matrix}=0.17$$

Consequently, the required column lies nearest column 13, $\frac{17}{100}$th way between columns 13 and 12. To find any other number in the required column, we have only to multiply the difference between two adjacent numbers of columns 13 and 12 by $\frac{17}{100}$, and subtract the product from the number in column 13. For example, to find the diameter of the partner to the 18″ step of cone A, we find the numbers 0.4750 and 0.4177 of columns 13 and 12, which lie on the horizontal line corresponding to $\frac{18}{60}=0.30$; the difference, 0.0573, between the two numbers is multiplied by 0.17, and the product, $0.0573\times 0.17=0.0097$, subtracted from 0.4750. This last difference will equal 0.4653, and will be the number sought. If we now multiply by 60, we will get 27.92″ as the effective diameter of that step on cone B, which is the partner to the 18″ step of cone A.

To find the companion of the 24″ step, we proceed after the same fashion; the horizontal line $\frac{24}{60}=0.40$ lies $\frac{1}{5}$d way between 0.39 and 0.42; hence,

In column 13, $0.3900-\frac{1}{5}(0.3900-0.3594)=0.3798$;

In column 12, $0.3294-\frac{1}{5}(0.3294-0.2975)=0.3188$;

And $0.3798-(0.3798-0.3188)\times 0.17=0.3694$.

The required effective diameter of the step, which is partner to the 24″ step, will therefore be $0.3694\times 60=22.16''$.

In like manner we obtain partner for the 30″ step, thus:

In column 13, $0.2944-\frac{2}{3}(0.2944-0.2600)=0.2715$.

In column 12, $0.2300-\frac{2}{3}(0.2300-0.1940)=0.2060$.

Also, $0.2715-(0.2715-0.2060)\times 0.17=0.2604$, and $0.2604\times 60''=15.62''$=diam. of step belonging to the same belted pair as the 30″ step of cone A.

The effective diameters will be:

12″ 18″ 24″ 30″ on cone A,
33 27.92 22.16 15.62 " B,

and the actual diameters when belt is 0.22″ thick:

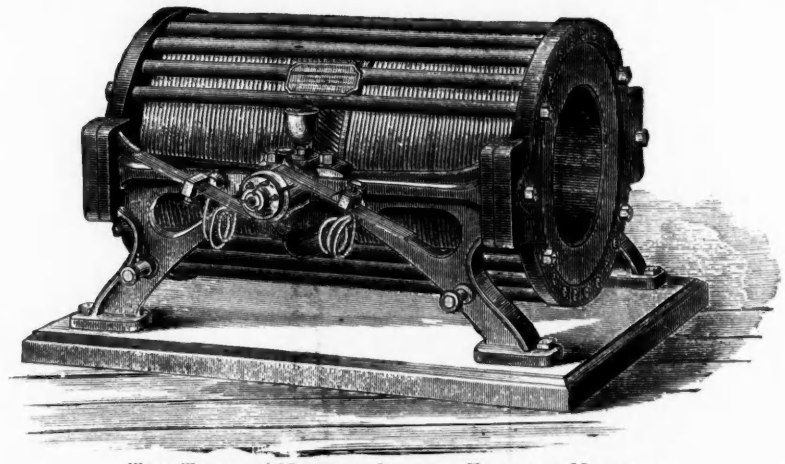
11.78 17.78 23.78 29.78″
32.78 27.70 21.94 15,40

and the length of belt is found to be:

$$[3.2252-(3.2252-3.1310)\times 0.17]\times 60''= 192.55''$$

In all the preceding problems it should be noticed that we arbitrarily assumed *all* the steps on one cone, and *one* of the steps on the other cone. It will be found that all of the practical problems relating to cone-pulley diameters can finally be reduced to this form, and can consequently be solved according to the methods just given.

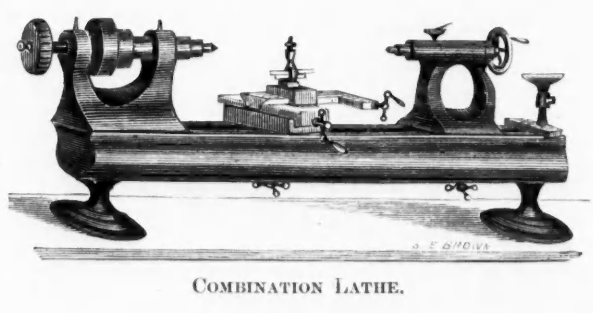
For those who find difficulty in interpolating, the following procedure will be found convenient: Estimate approximately the necessary length of belt, then divide this length by the distance between the centers of the cone pulleys; now find which one of the 33 lengths of belt (per unit's distance apart of the centers) given in the table is most nearly equal to the quotient just obtained, and then take the vertical column, at the head of which it stands for the companion to the right-hand column. Those numbers of these companion columns which are on the same horizontal line will be the companion steps of a belted pair. The table is so large, that in the great majority of cases not only exact, but otherwise satisfactory values can be obtained by this method, without any interpolation whatever.



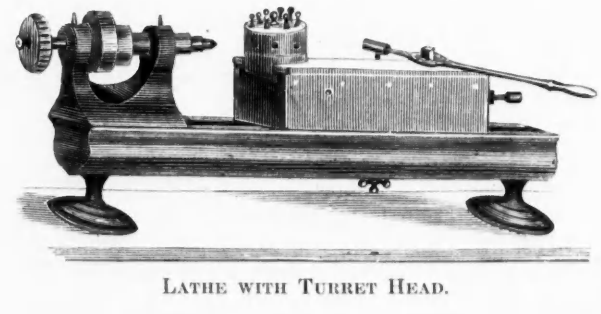
The Thomson-Houston Dynamo-Electric Machine.

The Thomson-Houston Dynamo-Electric Machine.

The cut on this page represents a dynamo-electric machine, for supplying a current to electric lamps, made by the American Electric Co., New Britain, Conn. There are in this machine but three coils of wire on the revolving portion or armature, and three pieces of copper in the commutator. The complete enclosure of the armature by the coils and magnets of the machine concentrates the power, and prevents injury to the moving parts or danger to the machine from objects being drawn into it. The spherical form and small size of the armature gives a minimum resistance to the air when revolving, thus preventing one waste of power. The commutator is simple and almost free from danger of insulation. The revolving parts are light and well balanced, thus giving but little wear upon the boxes.



Combination Lathe.



Lathe with Turret Head.

Pumps at High Altitudes.

By A. Falkenau, M. E., Leadville, Col.

Probably the highest mining camp where pumping is extensively required is Leadville. The altitude of the city is 14,000 feet above the level of the sea, and the barometer stands at 20.14″, hence the air pressure is 9.89 pounds. The mines are nearly all located considerably higher than the city, and some of those having to contend with water are fully 1,000 feet higher.

The column of water which the air pressure would support here is about 22 feet high. Practically, however, a 14 foot lift by suction is considered very good. I know of one case where a pump at a station throwing clear water lifted full 18 feet. This is a rare case, and one cannot expect the same result when sinking, as the water at the bottom of the shaft is dirty and gritty, and, moreover, there is more or less air pumped with the water.

A description of the type of shaft generally sunk in this part of the country will aid in understanding some of the difficulties encountered here in pumping.

The prospecting shafts are, as a general thing, 3×6 feet. When these become mine shafts they are frequently enlarged to 4×8 ft., and in a few instances to greater dimensions; the Chrysolite mine having one 6×12 feet, and the Denver City one 5×15 feet.

The shafts are divided into two or three compartments, generally two; the one being used as a bucket and the other as a ladderway. The ladder compartment is always the one used to place the pumps in. In a three-by-six shaft this compartment is 3×3 feet; and when we consider that an 8″ Cornish sinking pump occupies in a horizontal plane about 1½×3 feet, we see that there is hardly room enough for it in this size of shaft. I know of one case where the shaft not being well lined, the pump in being lowered caught between the timbers, and, in order to force it through, the column pipe had to be filled with water so as to add to the weight. Thus we see how the size of pumps as regards diameter is limited to rather small dimensions. Again, the length of stroke is limited on account of the low pressure of the air.

As mentioned before, the best average lift obtainable is about 14 feet. Most pumps in use at present are placed in shafts which are being sunk, and the pumps have to be lowered frequently. The greatest distance allowable from the top of the barrel to the surface of the water is 14 to 16 feet. With a 4-foot stroke the body of the pump will occupy about six feet in a vertical direction, and must be from three to four feet above the bottom to permit of working under it. Thus, after lowering the pump in position, the top of the barrel will be from eight to ten feet above the bottom of the shaft, leaving only four to six feet to be worked, after which the pump must be again lowered as the limit of suction is reached. If the stroke of a pump were greater the barrel would be longer and leave less length for suction, thereby necessitating the lowering of the pump still oftener.

Seeing, then, how the dimensions are limited in diameter and stroke, it is evident that it is impossible in any of these small shafts to place Cornish pumps of any great capacity, as they cannot be run at more than twelve to twenty strokes per minute. For this reason steam sinking pumps have found favor here, they being able to handle a greater amount of water with a small cylinder and short stroke than a larger Cornish pump; the difference being made up in the speed of running.

Certainly great objections to the use of steam pumps in mines present themselves, such as the condensation of steam in long pipes and the consequent cost of running, and also the annoyance due to the heat. There are other objections, such as the difficulties of making repairs and the wear of parts, which can be remedied by improving the present form of steam pump.

The steam sinking pumps mostly used here are the Knowles, Cameron and the Cope & Maxwell. In the first and last-named, the valves being of rubber wear out in a few hours under great pressure, and thereby cause delay and inconvenience.

I have now in my possession several valves taken from these pumps, which have been almost completely forced through the grated seat. In some cases even where the grate indented the valve but slightly, it caused it to break clear through, seeming to act like a shear. This occasioned great leakage, making the valve worthless an hour after it had been put into use. The pumping stations in the mines are generally two hundred feet apart. The combined metal and rubber valve, as used in the Cameron pump, gives universal satisfaction.

In sinking, as already mentioned, the water pumped always contains more or less dirt and grit, and hence the plunger form is preferable. The main objection to the Cameron *sinking* pump, as introduced in this camp, is that it is of the piston pattern. It is true that the water cylinders are provided with removable brass linings, yet where silicious sand has to be pumped, the wear is so rapid that it necessitates a very frequent setting up of the packing, for which purpose the lower cylinder head must be removed, causing delay, which should be avoided in mines when the water rises rapidly.

In the double acting form of pump, as manufactured by the Cope & Maxwell Co., the arrangement is so convenient that the packing can be set up while the pump is running. Although this pump is well designed as regards the adjustment and removal of parts, it is so bulky compared to its capacity that it can not be placed in our small shafts.

In this respect the Knowles pump is preferable, being of the plunger bucket form, therefore occupying less space comparatively, which is quite a consideration in a shaft.

I have now given a general idea of a few important points in the designs of steam sinking pumps, as used here.

At some future time I will write more fully on these points, and also upon the methods used in handling the pumps in the shafts.

Combination Lathe and Screw Machine.

The two accompanying engravings represent a small combination lathe and screw machine, built by A. C. Winn, 19 Howard Place, Boston, Mass. It is fitted with an improved form of slide rest, split chucks, a hollow spindle with conical bearings, and is otherwise arranged and fitted to make it a complete and perfect tool for fine light bench work. It takes up but little room, being about two feet long, and will swing 7″.

For making screws, a turret or monitor head takes the place of the slide rest, as shown in the engraving. This head is of approved construction and complete in every particular, making, in connection with the slide rest and other attachments, a complete lathe and screw machine, which takes up no more bench room than either alone.

Mechanical Drawing.

SELECTING WORK FROM THE WORKSHOP.

BY PROF. JOHN E. SWEET.

For another change of work, or to give the student a bit of experience here and there out of the great variety of work with which he will meet, both in the drawing and the work itself, I offer the following suggestion, as a lesson well worth his best exertions: Go into the workshop or factory, and select some apparently simple, well known and well-worn subject—line shaft hangers, oil cans, die stocks, pulleys, bolts, or anything of that nature. Settle upon which you will make a drawing of, and then study the subject as you progress. While you may or may not make the drawing to represent the subject you have selected, study every part by itself. Reason out why it is made as it is, why the different ones are not alike, which you consider the best, and why. Even to change the shape and size, to better come to your ideas, will in this case involve no loss, for the lesson in drawing is none the less valuable, while the lesson in thought is immensely more advantageous.

Never lose sight of the subject you are studying to think of the drawing, and never lose sight of your drawing lesson, and imagine some little contrivance you may hit upon is an invention and so forsake your good intentions, and go seeking the passport to poverty—a patent.

It is the business of the draughtsman, as well as the workman, to strive to improve both his work and his processes.

When the student has his subject, he may—in fact, is—tolerably sure to be at a loss as to how to represent it. A good deal he can find out for himself. Suppose it to be a pulley that he has in hand. An example might be given him, but he can turn to back numbers of the MACHINIST and see how Chordal does it, how other draughtsmen do it, and how the engraver does it; then he can take his choice. Either way is good enough; one way is exactly as good as another if the thing produced by the workman is the thing wanted, and the drawing is one that explains itself. If the subject is a bolt, the various ways that figured so conspicuously a few weeks ago in the MACHINIST will give the student abundant variety from which to select, and I fail to see why any of them were open to very serious objection. From either a man of ordinary sense would be likely to produce the thing wanted. If no dimensions were given, the draughtsman would be justified in making the bolt as long and as large as the drawing itself.

It will be better to study the bolts themselves and their uses and weaknesses, than to stickle over the best way to represent them. The weakest point in all ordinary bolts, such as shown at *a*, Fig. 26, is at the bottom of the thread below the nut, and a bolt subject to sudden shocks or severe punishments will stand much longer if reduced along its whole length below the thread, so as to be of the same strength as at the part threaded.

At *b*, Fig. 26, is shown Parsons' bolt, which is simply turned down from the thread to the head. Bolts so turned down proved to stand for securing armor plate, when bolts left full size would not stand at all. And, two bolts of this form will outwear a dozen common bolts in the tool holders of planing machines. There is shown at *c* a Pallisser bolt, simply another form of reducing the strength of the bolt and yet have it fill the hole, but more expensive to make than the Stroudly bolt, shown at *d*. This is only an ordinary bolt with a hole about half its diameter drilled down its center to the ending of the thread.* (See dotted lines in cut.)

Bolts of either of these patterns are better in certain places than the common kinds, and among other advantages is the one that the nuts will never shake loose. If the subject selected be a line shaft hanger, and the article cannot be taken to the drawing stand, make rough sketches, and figure the dimensions in a sufficient number of places to enable you to complete the drawing, without going again to look at the original. This will require the making of many cross sections and views in two or more directions. Avoid the usual mistake of making the sketches too hastily or incomplete. The man who can make a first rate sketch is already half a draughtsman.

As an example of what the lesson above suggested is likely to lead to, the following study of the monkey wrench subject may be suggestive. And if the student finds nothing better—this is as good as any for a subject to make a drawing of—use some real article, instead of copying the one here represented.

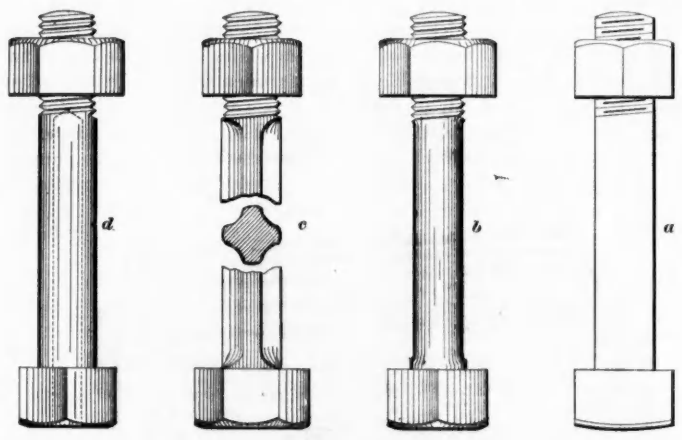


Fig.26

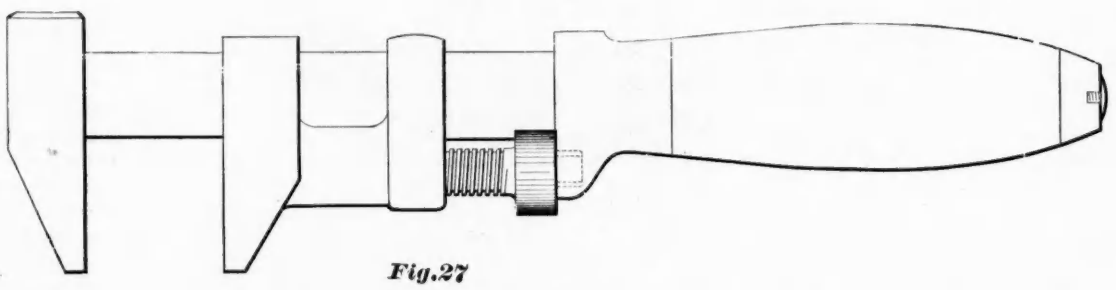


Fig.27

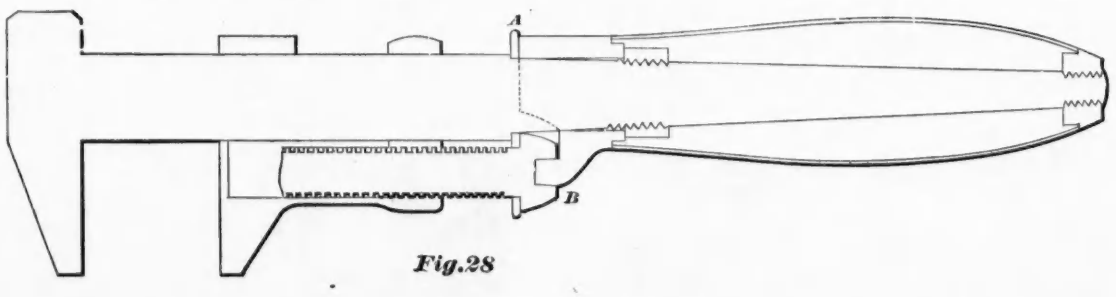


Fig.28

As this drawing was made for the engraver entirely by the use of a square, scale, triangle, French curve, pencil and inking pen, the student will need no tools but such as he can make.

If you have an opportunity to roam through a shop of any considerable size, you will find various tools of this class, likely of many makes and in various stages of ruin. Nine out of ten will be bent in the bar between the jaws. All will be loose to a greater or less extent, so that the free jaw can be moved from a sixteenth to an eighth of an inch. Some will have split wood handles, and other symptoms of room for the production of a nobler species. Some way to make the bar stronger, without making it heavier or more bulky, is just the problem that is open to you, as well as to all other men, for consideration.

If the wrench is one of the small milled headed screw kind, as shown at Fig. 27, you will probably discover the cause of the lost motion is mainly due to the wear in the small shoulder against which the screw works, and if you have had much experience in using a wrench, you may have met the trouble that often occurs, of having it shifted by the screw coming in contact with the work.

One might think both these defects could be remedied by the introduction of the steel plate shown at *A*, Fig. 28.

The changes shown at *B*, of making the pin on the abutment, instead of on the screw, gives a better opportunity to work the screw by the thumb, than the old plan.

One of the most serious difficulties to overcome in the constructing of wrenches of this class has been that of securely fastening the abutment to the bar. A much more serviceable handle than the wood ones employed could be made of iron or steel tubing, as shown in Fig. 28, and some such construction would become a necessity were the other parts of the wrench made as durable as it would seem such a tool ought to be. As constructed now, all parts give out at about the same time, so that the repairing of one is seldom thought of. To prove the worthlessness of the improvements or changes here indicated, it would only be necessary to make the plate shown at *a*, of cheap iron. The study bestowed upon the subject is none the less valuable, however, because of the worthlessness of the assumed improvements. The apprentice or student who will take the trouble to go through with this or any of the subjects hinted, will find himself ever after taking a deeper interest in line shafts, or wrenches, bolts or whatever he may take up, than he ever would otherwise, or would at first imagine.

NOTE.—From the drawing with a heavy shade line, one machinist might make the collar of his bolt 1-64th of an inch less than ¾ in., and another, by measuring to the other side of the line, make his 1-64th over, and yet each be right, for either might be as near as the man wanted. Though in this case the machinist would not be justified in making it anything but ¾ in., unless he knew its purpose and the requirements of the job. Accuracy in drawing, as well as in the work, is a matter of degree. Heavy castings and forgings may not be obtainable to within the 1-32nd or 1-16th of an inch in size. Engine and machine tools may require an accuracy of $\frac{1}{5000}$th of an inch, and standard gauges made with a variation not to exceed the $\frac{1}{20000}$-th of an inch. To make the drawings for the rough castings to within a hundredth of an inch is a waste of time, and to attempt to draw the standard gauges with any such precision as is required in their construction would be a failure for it can not be done. So whether a drawing is made with an accuracy that admits of its being measured to determine sizes and distances, turns upon what it is for, or the class of work it represents.

The man who adopts the conventionality of adding shade lines to all of his drawings, is liable to use them in places where it would be better to leave them off, and the one who never uses them omits that which often adds greatly to the ready comprehension of an unfamiliar subject. A friend has adopted the system of making drawings after this fashion: All finished work is represented by fine lines, and all work to be left rough in heavy lines.

This is a conventionality as sensible as any, but is a matter to be settled by the proprietor and not by the draughtsman. If the student only goes far enough to learn to read drawings, and if he does not wed himself to any particular way or style, he can better adapt himself to the ways of his employer.

Practical Steam Engine Economy.

No. 2.

BY F. F. HEMENWAY.

The consideration of steam engine economy in its connection with the problem of a change in load, and as it presents itself to the user rather than to the builder, is not complete without touching the matter of a load materially lighter than that for which the engine was designed. In a previous number, the question of an increase in load of 50 per cent. was considered. Suppose, now, that instead of increasing the load 50 per cent., it is diminished to the same extent. The opinion has already been expressed that this is likely to be the case. Considerable observation leads the writer to believe that at least four out of five steam engines in use are underloaded, and I believe the experience of those who use the indicator extensively will sustain this opinion. Practically and theoretically, good fuel economy from a cylinder greatly too large for the load is impossible. The reasons for this, while well understood by engineers are not so generally appreciated by those who own or use steam engines, nor by those who have them in charge. Briefly stated, it is because the useless work done is too large a percentage of the total work, which may readily be seen by considering approximately what the work done in the cylinder consists of.

Take, for instance, the engine previously referred to, that is working at 100 effective horse power, gauge pressure 80 pounds, and cutting off at ⅛ stroke. Such an engine will indicate, say 112 horse power, 12 horse power of which will be useless work or friction. Further, there will be done 48 horse power in expelling the atmosphere from the cylinder. The total horse power will thus be 112+48=160, of which 62 per cent. is effective. If, now, the effective horse power be reduced to 50, the friction will be, say 9 horse power, and the work done against the atmosphere will be as before, 48 horse power. The total work will be 107 horse power, of which only 46 per cent. will be effective. But this is not all. It is well known that an uncertain quantity of steam is condensed in the cylinder to restore the heat lost during expansion and exhaust, this quantity being in addition to the condensation for the work done. Although there is but little known as to cylinder condensation, there are reasons for believing that in unjacketed cylinders and with saturated steam, the *total* condensation with the same pressures and for a wide range of cut-off is nearly constant; so that to put it plainly, if it take three-quarters of a pound of coal per horse power per hour to supply the heat lost in this way, working at 100 effective horse power, it will require 1½ pounds per hour if only 50 horse power of work is done with the same engine.

In the case of an engine enormously underloaded, there is this remedy possible: Reduce the piston speed, thereby reducing the

useless work done against the atmosphere. At this none of the loss from condensation will be prevented, which loss is serious, and becomes comparatively more and more so as the useful work is diminished. With reference to the slower speed: the theory of high speed has been so widely and so ably advocated that many have become impressed with its utility, without reference to other conditions; that is, they lose sight of the argument that high speed is advantageous chiefly because it results in a good deal of work from a small cylinder, thereby decreasing the loss from condensation, and that it has no economic relation to a large cylinder and little work. My experience is that in a non-condensing engine, working at ordinary steam pressure, and cutting off less than ¼ stroke, better economy will result from diminishing the speed until the cut-off is at or beyond that point. The same result will not obtain by reducing the steam pressure and extending the cut-off, keeping the speed the same, because the gain from using steam at reasonably high pressure is greater than the loss from cutting off too early, and because the useless work of friction and against the atmosphere is not diminished.

Quite naturally since the value of working steam expansively has become understood, it has been carried to excess; and to cover the mistake, it has been assumed and gravely argued that for some inexplicable reason the benefit of early cut-off cannot be realized, and that practically expansion cannot be carried to the extent indicated by theory, which latter assertion may be doubted.

Take again, for example, the engine previously referred to, as loaded to 100 effective horse power, and indicating 112 horse power. Such an engine will work with an accounting by diagram of 22 pounds of water per effective horse power per hour, and as theory comprehends the fact that in such a cylinder (unjacketed and with saturated steam) there will be about 600 pounds of water condensed per hour, it follows that theoretically, as well as practically, there will be used about 28 pounds of water per horse power per hour.

If, now, the cut-off be extended to ¼ stroke, the cylinder condensation will not be materially different, the effective horse power will be increased to 120, the steam accounting by diagram will be slightly increased, but theoretically, because of the less percentage of condensation, there will be required but 27½ pounds of water, in place of 28 pounds. If, in like manner, the investigation be further pursued, it may be similarly demonstrated that the theoretical water consumption, anywhere between ¼ and nearly ⅛ cut-offs, is less than at any cut-off earlier than ¼ stroke. As this is sustained by practice, it seems time to admit that theoretical economy is practical economy, and that the reason why they have been taken to be distinct is for no fault of the theory, but rather in its application.

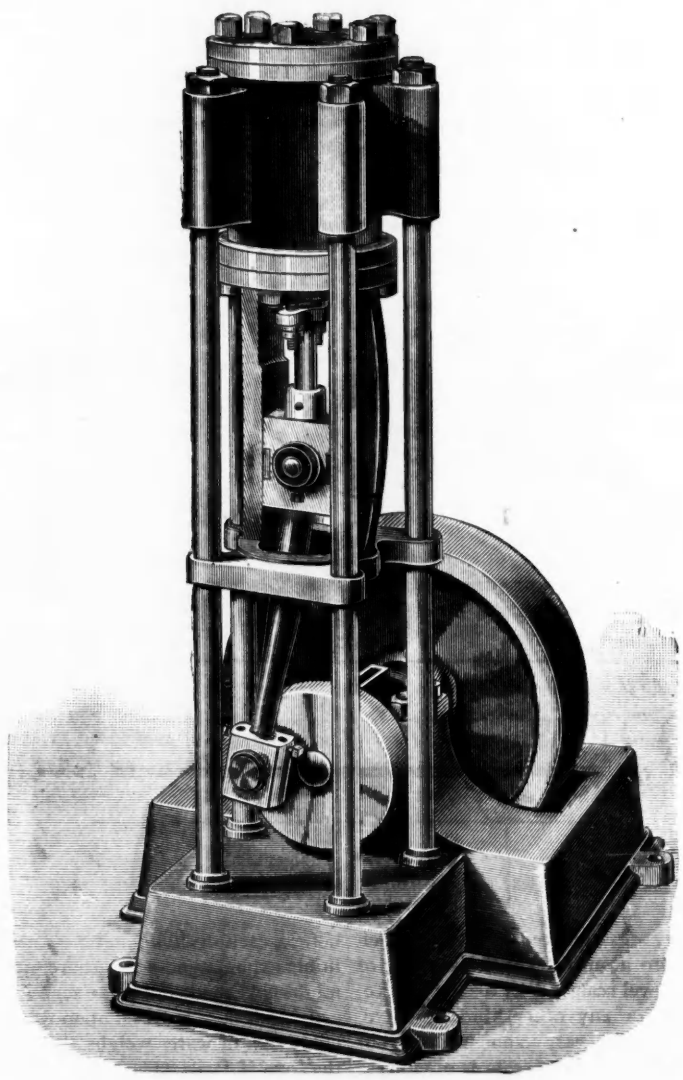
If there is a well-considered theory that demonstrates economical results from cutting off at less than ¼ stroke in a non-condensing engine, with steam at 80 pounds, it ought to be advanced.

The practical application of a correct understanding of the theory of steam engine economy, as applicable to the type of engine noted, is: never hesitate so far as economy in fuel is concerned, to extend the point of cut-off to ⅓ of the stroke, and never expect a gain by increasing the speed, unless the cut-off is nearly as late as that.

There are excellent reasons why the builder should rate his engines at ⅛ stroke; excellent so far as the user or buyer is concerned, since the loss from early cut-off is not serious at that point, and since it affords a large margin for regulation and for increase of load. The reasons that influence the builder to adopt this rating should not, however, lead the user to conclude he cannot increase the load on such an engine 50 per cent. without losing anything in the way of fuel economy.

Never use a safety valve with a wrought iron stem rigidly attached to the valve and just a sliding fit through a cast iron cover.

There is in Paris a society having for its object the providing of better homes for the working classes. To this end they have already erected several buildings by way of experiment, they being neat in design, commodiously arranged, and situated in the center of a plot of land containing one hundred and fifty square meters. Each house contains five rooms, and, together with the land, costs the society five thousand francs. These houses are rented at two hundred francs per year, being four per cent. on the outlay. In order to provide a way for the tenant to own his own house, it is agreed that by paying yearly an additional two hundred francs, he shall at the end of eighteen years receive a deed. The projectors of this plan do not expect large returns, but content themselves with a moderately low rate of interest on their investment. The success of the first buildings has been so gratifying that the society is to increase its capital, and erect others at once.



A New High-Speed Engine.

A New High-Speed Engine.

Our engraving represents a new high-speed engine, recently brought out by Marcus Ruthenburg & Co., of No. 2 Home street, Cincinnati, O. It will be seen that the usual frame, or housing, is replaced by four distance rods, which are made of steel, and serve to hold the necessary parts of the engine together, and in position.

The connecting rod, which is the only forged piece of the engine that is made of iron, is fitted at the crank end with the marine or English type of boxes, which are turned instead of planed together, it being claimed that by this way of fitting the possibility of any other than a direct tensile strain on the bolts is avoided. At the cross head end the pin is made fast in the rod, and extends either side in the form of journals, which are embraced by steel bushes in the cross head. These bushes are split open on one side, and the adjustment is made by means of three small keys or wedges, arranged to be moved by nuts on their ends, by the operation of which the bushes are closed around the pin. This form of cross head gives two long bearings that are well separated, and the length of the rod is not changed in the adjustment. The fly-wheel pulley is turned all over to preserve the balance, and no counterbalancing is resorted to, except such as is made by the permanent distribution of metal.

Clearance is reduced by the means of short ports and close travel of the piston; and the distribution of steam is effected by a plain, flat slide valve.

Pains have been taken in the design to render the parts easy of access, and to provide means of adjustment for wear.

These engines are built in sizes from 5″ × 5″ to 12″ × 12″, either single or double cylinders, connected at right angles or directly opposite. One of them, with two cylinders, 7″ × 7″, connected at right angles, may be seen in operation at the Cincinnati Exposition.

An engineer may lift the lever and weight of a safety valve without raising the valve. This should be remembered.

LETTERS FROM PRACTICAL MEN.

Hardening Steel in Liquids and Compounds.

Editor American Machinist:

With your permission I beg leave to say that a "flux" may be admissible in welding or melting, but *never* in hardening. Whenever steel is heated for hardening, sufficiently hot to make the word flux applicable in describing any treatment to which it may be subjected, unless subsequently hammered, or worked otherwise, it will be injured past a possibility of doing the best work of which it was capable, if properly treated.

"Percentage of carbon contained" is but one of the factors in determining quality. The very worst quality of steel might contain exactly the percentage of carbon required for any particular use, while for the same use steel of the very highest quality might prove worthless, simply on account of insufficiency of carbon.

"No matter what kind of steel is used, good results will *always* follow." If, by this, is meant that a poor piece of steel may by careful treatment show comparatively good results, Yes. If by "good results" are meant such as are sure to be attained by the use of first-class steel, properly treated, without the use of *compounds*, Impossible. "Join the atoms of carbon and iron." "The steel will become very tough and hard." A "thinking cap" is necessary, is it? Well, here goes: If two pieces of steel are heated precisely alike and plunged at the same instant, one into clear cold water, the other into "resin, tar, oils or others," and allowed to remain till cold, on breaking them we shall find, *if they have both hardened*, that the piece hardened in oil is tougher, and shows a finer grain than that hardened in water.

Why? Simply because the piece hardened in water cooled so suddenly that the steel, in its change from hot to cold, had not time to arrange its crystals in the same "compact" condition as that hardened in oil. Then oil is the best, is it not? As a means of protection against the results of overheating, Yes. As a necessity for producing the greatest toughness, hardness, and fineness of grain, No.

Going back to the two pieces under consideration: If the heat was great enough to harden in oil, it was *too high* for hardening in water. By heating the piece for hardening in water, at a lower heat, *i. e.*, right heat, it may be put in its strongest, hardest, most "compact" condition, at a heat so low that it would not have hardened in oil. Now, with "thinking cap on," will "Flux" tell us whether it is not true that the lowest possible heat, compatible with the degree of hardness required, is the best?

Heating steel opens the grain just in proportion to the degree to which it is heated. Quenching catches and holds the grain in its open condition in greater or less degree, just in proportion as the quenching is more or less sudden. In heating for hardening, the greater the heat the greater will be the change in size and shape, and the more will all finished surfaces or delicate edges be injured. Is it not evident that this question has two sides?

Shall we, for the sake of using some compound in which to quench steel for hardening, or with which to besmear it before the final heating, consent to heat it *too hot?* Or shall we quench in that, which by sudden cooling, permits us to harden at so low a heat as to preserve more nearly the original size and shape, and all delicate work intact? S. W. Goodyear.

Pittsburgh, Penn.

Efficiency of Balanced Valves.

Editor American Machinist:

I was somewhat amused at Chordal's remarks on the millwright. Having had experience with millers and their work, I thought it might prove interesting to your readers to narrate a little of it. Millers, as a rule, are the most conceited crowd I have ever encountered outside the proprietor of a small job printing office.

I once had a job for a miller—putting a balanced valve on his engine, and he bothered me more than the job I can assure you. He got so worried because a rival machinist (Chordal?) told him that I was spoiling the engine, that he sent to New York to get a civil engineer to see what I was doing and how I was going to come out. The consequence was I was ordered out of the mill. I might as well acknowledge that I am the "man with a balanced valve," whom Chordal and others have taking so much delight in abusing through your paper. I declined to go unless paid for the whole job, which the miller refused to do, and suffered rather to have the work go on. Time rolled on; the job was finished, and the miller said he had never made a purchase since he had been running the mill which gave him so much satisfaction. It has been running night and day for a year and no complaints. There is no patent on the valve. Anybody can make a piston valve of cast iron, and if not provided with packing it will last a long time; and if the hole is bored smooth or reamed and is round, and the piston fitted nicely, it will lay over the plain slide valve every time. I have one 5½″ diameter running 100 horse power, which has been in use fifteen months, and shows no sign of wear. I noticed a description in your valuable paper a short

time since where the engine is not provided with means to take up the wear on connecting rods or boxes, but has a piston valve with elastic packing. I would not have a piston valve unless the pistons were solid iron. Any engine which has an automatic lubricator can run a piston valve without wear.

Some people talk about steam cut. There is no such thing as steam cut. Iron will corrode when subjected to highly-heated dry steam; but if the steam is constantly oiled it will neither cut nor corrode. If there was such a thing as steam cut, steam pipes would soon cut away at the elbows, and so would the ports of an engine, and the corners of the houses in cities would become rounded from wind cut. I examined an old brick house one hundred years old, and find such is not the case.

I shall undertake to defend myself and brotherhood of balanced-valve men from the unmerited abuse which has been heaped upon us. BALANCED VALVE.

Baltimore, Md.

Review of Sackett's Drawing System.

Editor American Machinist:

It is considered much easier to find fault with others' ways than to correct those that may be amiss in ourselves, or to improve upon ways in our own management. As Chordal's bolt was the means of bringing out expressions from so many different writers, I doubt not that his copy of "Sackett's Drawings" will be of equal value, in developing the different ways of preparing working drawings for shop use.

Considered in the light of working drawings, these copies or pictures of Sackett's drawings do not represent the machine of which they are supposed to be a copy on paper, since there appears to be no regular scale or proportion to the figures; furthermore, they do show parts that could be given in as small space, and in a much more convenient style, by a written description than by the representation as per card.

Taking his card No. 1, the articles shown by 01. 03. 04. 05. 06. 07. and 09. can be removed, and Nos. 1., 3., 4., 5., 7., given as follows:

No. 01.—1 shaft	1½″	O	iron	21½″ long
No. 03.—1 piece	1″	O	"	4½″ "
No. 04.—1 "	1″	O	"	4¼″ "
No. 05.—1 "	½″	O	tool steel	5″ "
No. 07.—2 "	¾″	O	best iron	4⅞″ "

Nos. 06. 08. 09. would hardly be considered forgings, and can more correctly be given on Card No. 4.

Card No. 2 can also be somewhat reduced by the removal of 08 and 09, and as for 04. I read "Drive in *E*," "free in *K*," "$L\frac{13}{16}$," also "*L* in pulley" on No. 010.; and the *L* is also placed in connection with 08. and .07. This may mean something in regard to length or size, but I find nothing that will indicate such to be the fact.

Regarding Nos. 06. 08. 09., let us add to "List of Pieces:"

1 washer, 1½″ dia. ⅝″ hole, $\frac{3}{16}$″ thick.
4 Cap bolts, ⅝″ dia 2″ long, Hex. head.
4 Hex. nuts, ⅝″ " 1″ across square.

These articles can be made a standard and kept in stock as well as gas fittings, machine screws and wood screws. They certainly can be purchased of some established manufactory, at a much less figure than they can be manufactured in small lots.

The instructions are as complete as one would wish, and show each department what its special duty is and how it should be done. Though rather oddly worded, they express the idea desired, and we all know that no two parties can express the idea, "I want to borrow ten dollars of you," in the same words. I doubt not but what each firm would want to change, if it is simply for the fact of changing.

Taken as a whole, I consider this plan far superior to others in use in some of our older establishments, where the absence of the foreman puts a dozen men to hunting for this stick or that stick, for this or that scrap of paper, or where two or three men turn over a bundle of greasy sticks a dozen times, and then find that "it's ½″ longer than this stick," and the other is "to that notch on that stick."

Mark Twain recommends his scrap book, on the plea of a "saving in breath," and a reformer of morals," as it would save two years in a man's life on account of its preventing profanity.

Now I consider "Sackett's drawings" in the same light, for nothing hurts a man's feelings so much, unless it is hitting his thumb with a strange hammer, as to find the patterns lost, or that "the sticks shrunk endways," and he has turned up ⅛″ too far.

Without endeavoring to set myself up as a model, I would suggest that, in figuring drawings, all lengths be placed on or above the upper line that is to be shown, and that the diameters be given at the horizontal lines as shown in cards No. 1, No. 01 or 04, also No. 6 in card No. 3. DIVIDERS.

Worcester, Mass.

Bevel Seated Safety Valves.

Editor American Machinist:

Notwithstanding the many refinements in modern engineering practice, there are still many old fogy ideas adhered to, among which none are more absurd than the making of valves with bevel seats. Why a safety valve, poppet valve, or any other kind of valve, should have a bevel seat, no one can tell; but why they should have flat seats is obvious to every thinking mechanic. A valve with a flat face may be fitted very loosely in its guides and still close perfectly tight, while one with a bevel face, if loosely fitted, may seat out of the center, and, if it does, it cannot be tight, unless the face be spherical, which is never the case in practice. If closely fitted, any valve is liable to stick, and many safety valves do stick, causing explosions, as we learn from the papers every week. A few years since a boiler on H. M. S. Thunderer exploded from this cause, being provided with a bevel seat safety valve, closely fitted in the guides to prevent leakage in a rough sea, and loaded with dead weights. It seemed not to have occurred to those in charge to use a flat-face valve, with plenty of room in the guides. If a flat-face valve does slide about in its seat in a rough sea, it will nevertheless be steam tight. What is true of safety valves is also true of pump valves, and perhaps of all other valves.

In speaking of explosions, perhaps I ought to mention a circumstance that occurred near this place in a saw mill. The safety valve had been very leaky, and the engineer had placed a rubber gasket under the valve. The engine was standing still, and all hands were out getting in a log. Steam accumulated until this rubber could hold no longer; the lever, with weight and valve, suddenly snapped with a terrific noise, and relieved the boiler without any damage. No coroner—no verdict. FORTY-NINER.

A Covering for Steam Pipes.

Editor American Machinist:

I have found the following to be a first-class non-conductor, and a cheap covering for steam pipes: Coal ashes, sifted through ¼″ mesh, 4 parts; sour flour or cheap rye flour, 1 part; calcined plaster, 1 part. Masons' hair, enough to stick it together. It should be put on when pipes are hot.

It should be mixed very stiff, so as to have as little moisture to dry out as possible, and no more mixed than for a day's use, as the plaster becomes "dead."

In covering small pipes, it is of advantage to suspend a narrow board about 1½ inches below the pipe, and plaster on to that and around the pipe, as it saves time.

Waterbury, Conn. W. E. CRANE.

Water Power and Water Privilege—How to Compute their Power and Efficiency.

Editor American Machinist:

"The following" rule is from a popular "trade journal:"

The following rule will give the power of water wheels: H.P. = .001012 h in low breast wheels; H.P. = .00113 in high breast wheels; H.P. = .00128 in overshot wheels; 2 = quantity of water in cubic feet per minute; h = head of water in feet.

1. If the author had placed q h after, or before, each decimal, and a q, instead of a 2, in his explanation, a fair share of his readers might have made out some sense to his rule.

2. As it is, it is based upon the fact that a cubic foot of water weighs about 62.33 lbs.; that one H.P. = 33,000 lbs., raised one foot high in one minute, together with the supposition that the average efficiency of a low breast wheel is as .54, a high breast as .60, and that of an overshot as .68 to 1.00, or thereabouts.

3. In other words, for every cubic foot of water applied upon a low breast wheel we realize but 33.66 lbs. of it in work; the other 28.67 lbs. being used up in friction and imperfect application (62.33 × .54 = 33.66; 62.33 — 33.66 = 28.67). If applied upon a high breast wheel we get 62.33 × .60 = 37.40 lbs. of it in work, and 24.93 lbs. is loss.

If applied upon an overshot we get, 62.33 × 68 = 42.38 lbs. of work, and 19.95 lbs. is loss.

4. To find the potential energy of any water privilege we multiply the available quantity of water, in cubic feet per second, by the weight of one cubic foot, by the head, in feet, or height of the falling water: the product will be the potential energy sought, in pounds raised one foot per second, or falling one foot per second so long as the supply of water is constant; called also foot-pounds and dynams.

5. To find the nominal H. P., or potential energy in terms of horses' power, we divide the product of the three above factors by the constant 550; which means 550 lbs. raised, or falling one foot every second, or 550 foot-pounds = 550 dynans, and if continued one minute the work done will be sixty times as much in sixty times as much time (60 seconds); 550 × 60 = 33,000 lbs., raised one foot in one minute, or one pound raised 33,000 feet in the same time is the generally accepted standard of what constitutes *one horse power*, as, indeed, has been since the days of Watt.

6. If we put the rule in algebraic language, we have Q = the quantity of water in cubic feet per second; H = the head, in feet, or heighth of the falling water; and the known factor 62.33 = the weight in pounds of one cubic foot of water at 60° Fah.; and (*A*) $Q\,H\,62.33$ = potential energy, in foot-pounds, pounds raised one foot per second, or dynams.

7. For the nominal H.P. we will have

(B) $\frac{Q\,H\,62.33}{550} = Q\,H\,.1133 =$

HP (62.33 ÷ 550 = 0.1133).

8. Many prefer, with the author of the rule quoted, that Q = the quantity of water in cubic feet per minute. In such case we will have

(*C*) $\frac{Q\,H\,62.33}{33,000} = Q\,H\,.001889$ = nominal H. P.

9. In practice we shall always realize much less than this, depending very much upon the kind and quality of the motor employed. If low breast of the very best construction, the efficient power, or useful effect, may reach .60 (60 per cent.) of the potential energy; if of bad design, on a low fall, the efficient power will very likely be below .40.

The same remark as to quality holds good in case we use a high breast, an overshot, or a turbine wheel. The efficiency will vary accordingly from .50 to .70 on the high breast, from .60 to .80 on the overshot, and from .40 to .90 on the turbine wheel.

10. Now if in (*B*) we put the weight utilized per cubic foot, in place of the actual weight of every cubic foot of water used (see 3), we will have (*D*) $\frac{Q\,H\,33.66}{550} =$

$Q\,H\,.0612$ = H. P. actually transmitted to the first driven gear, and the simplest possible formula for the low breast wheel.

11. If Q = quantity of water in cubic feet per minute (see 8), and we put realized for actual weight in (*C*), we shall have (*E*) $\frac{Q\,H\,33.66}{33,000} = Q\,H\,.00102$ = H. P., actually transmitted as above (10); the decimal portion being nearly as in the quoted rule. Had the realized weight been 33.396 instead of 33.66, the decimals would have agreed. Were all fractions accounted for they would do so. By the same method we get for high breast (*F*) $\frac{Q\,H\,37.40}{33.000} = Q\,H\,.00112$ = H. P., and for the overshot (*G*) $\frac{Q\,H\,42.38}{33,000} =$

$Q\,H\,.00128$ = H.P.

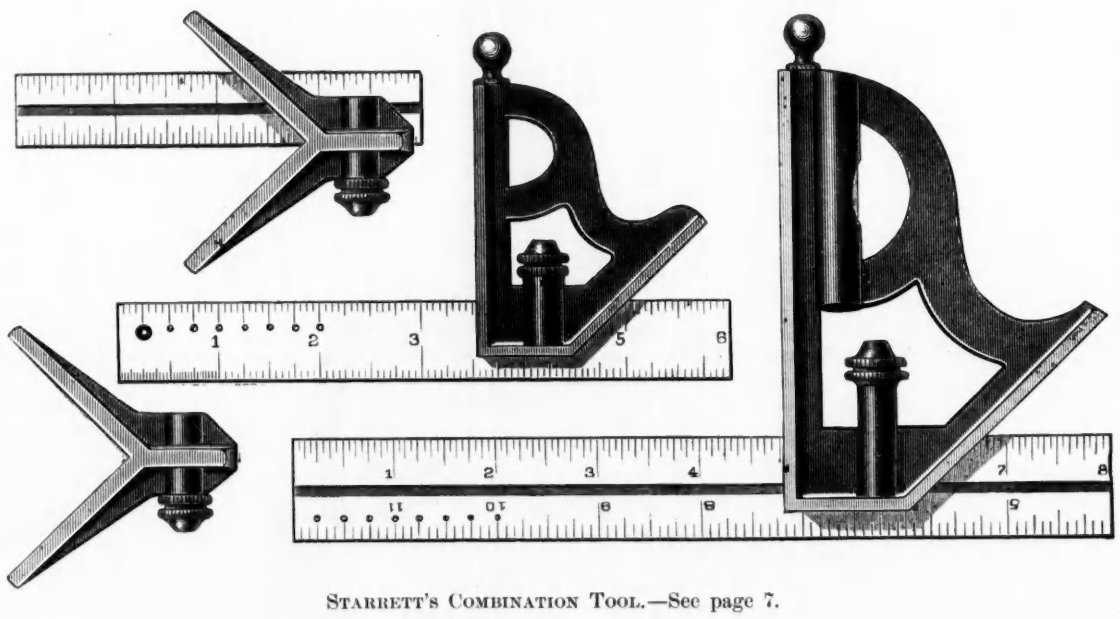
12. There are many reasons why the simplest formula (*B*) is to be preferred to any other. Giving as it does the whole energy of the privilege, in terms of horses' power, any one can easily apply such co-efficient of efficiency, or useful effect, as he may in his judgment deem best.

The result is an absolute standard, by and with which every competent mechanic and mill owner can compare the statements of those who make and set up water wheels of any kind.

All of the formulæ used in hydraulic engineering give results per second of time.

Reason enough if there were no other.

North Chelmsford, Mass. A. M. SWAIN.



STARRETT'S COMBINATION TOOL.—See page 7.

The fall meeting of the American Institute of Mining Engineers will be held in Harrisburg, Pa., beginning Oct. 25th. The Society will give notice to members, of the programme of the meeting.

Extracts from Chordal's Letters.

MR. BAKER BUILDS A MILL WITH DOORS AND A LEAN-TO—A REFORMED CONSUMPTIVE PERSUADES HIM TO INVEST IN A HYPHEN—HOW THINGS TURNED OUT.

Mr. Editor:

* * * * A certain Mr. Baker, within the range of my acquaintance, has a mill, and grinds up wheat for a living.

Mr. Baker is a progressive man in his section of the world, but elsewhere he might be looked upon as a fogy. We look upon all men as fogies, who fail to act upon the suggestions of well-established, economical principles and practices. May it not be true that many of these fogies are really men of progress, who for some "reasonable" reason cannot accept many of these same principles and practices as "established?" May there not be something in the atmosphere surrounding some men, which perverts the ordinary established laws of economy?

* * * * I know Mr. Baker to be a man who thinks for himself and for others, and a man alive to the general advance of human affairs. But when you see his mill, you see an old-fashioned mill with a roof, having just enough of mansard qualities to be ugly without and awkward within—robbing the universe of space, without giving it to the mill. Such a roof was put on Mr. Baker's mill, because Mr. Baker had seen profitable mills with such roofs on them. The front door is a double-barreled affair, so fixed that the top section can be opened and the bottom left shut, or the bottom can be opened and the top left shut, or both be opened, or both be left shut. This door is certainly a very ingenious and wonderfully contrived thing, and I have no doubt that it is a very useful thing to have about a mill, but not being a miller, I am not able to explain its special utility with reference to mills. I only know, that when the two several doors are properly adjusted with reference to each other, and to the mill, and to the miller, the contrivance is very handy for the miller to lean over when he looks out upon the world from within the mill. I furthermore know, that many paying mills have front doors constructed and arranged to operate substantially as set forth.

Mr. Baker knew this also, and probably saw no reason for putting in any other kind of a door. Mr. Baker is keen to act on established certainty, but is slow in matters of risk.

* * * * When Mr. Baker built his mill he built a lean-to behind it. This was for an engine and boiler room. I regret being unable to set forth the advantages of the lean-to in industrial architecture. It may be that a lean-to is suggestive of growth. I think it must be. Certainly a mill or any other sort of factory building which is self-contained, may be said to be in an experimental stage. The thing may succeed and grow, and it may not. But when the lean-to begins to develop, we may safely judge that the business has grown beyond original anticipations. If this is a reasonable theory, is it not also reasonable for a miller to build the lean-to when he builds the mill? Does it not, in a way, show confidence in the expectation that the mill business will exceed present anticipations? Millers are supposed to have good reasons for what they do, and Mr. Baker built a lean-to when he built his mill. Mr. Baker was not a miller then, but he intended to be, or he would not have built the mill.

* * * * Within Mr. Baker's lean-to was a steam engine of a popular form, designed on well-established principles of construction—that is to say, many of the engines had been used with satisfaction in paying mills.

The engine was a plain, long-stroke, slide-valve, rock-shaft affair, and there were few peculiarities about it.

In those few disparities from common practice, the designer seemed very careful not to tread on delicate ground.

The exhaust passage all round and all over the cylinder, to form a jacket to prevent loss of heat, while not common on such engines, was an arrangement whose expediency was obvious, of course. So also was the small cross-head friction surface. Any body could appreciate the importance of so proportioning wearing surface, that the engine would not eat all its power up in its own friction. The little cross-head brasses were of brass, as all brasses should be; and there were set screws to set these brasses up with. Any body could see that this set screw arrangement had established merit. If the cross head got out of line it could be got back by means of these set screws, and when the brass wore away, the set screws were always ready to set them up.

Another merit of having an adjustment on the cross head was this: If the engineer set the brasses so tight as to heat and cut, he could loosen up by these features of adjustment. Can anything be plainer?

If there were no means of adjustment, how in the world could he loosen up things that would in some manner get too tight? There being take-ups all over the engine, it is only to be expected that sometimes something would be left so loose as to pound. In such cases an adjustable cross head is of incalculable value, because the engineer can tighten up the cross head, and thus see if that is where the knocking comes from. An important function is thus seen to be added to a common cross head, for it may become the seat of a knock, and, having features of adjustment, the knock can be stopped; while, if the cross head was not adjustable, the knocks would probably be concentrated in those parts of the engine which were adjustable. What engine could stand this for any length of time? Imagine an engine adjustable only at the crank brasses. Would not all the knocking occur at this point, and would not these brasses soon knock themselves to pieces, and would not the engineer have to devote himself and his wrench solely to those brasses? How much better, then, to put set screws in the cross head, and in the eccentric strap, and in the outer pillow block, and in the piston packing? By this simple means it is possible for a knock to be stopped without really touching the cross head, for the knock may be elsewhere.

* * * * Mr. Baker's engine had a long stroke and a slow motion, and it had them bad. But the engine was simply an element in the mill, and its duty, in its small way, was to produce rotary motion of certain mill machinery by methods whose utility had been established.

This engine not only had a long stroke, but it had also a short valve, by means of which the steam could be utilized during the entire stroke. What would be the use of having a good long-stroke engine, and then only using the steam port (where all the power *must* come from) a part of the time? No, sir? No cutting off in this engine—not this stroke, anyhow. Maybe, when the engine was built, it was intended to cut off a little; but it had deferred doing so from one stroke to another till the desire had passed away.

* * * * Mr. Baker's smokestack pointed to perpetually sunny skies. The invigorating influence of contrasting seasons was lacking in Mr. Baker's latitude. Mr. Baker's mind was always progressive, as hereinbefore stated, but I have noticed that Mr. Baker's progressive actions of body partook of the nature of impulsive spurts after certain visits to lands of snow.

* * * * The consumption of coal per horse power per hour does not depend so much upon the geological conditions of a locality, as upon the geographical location. A high price for coal does not insure that means for economy in its use will be applied. Statistics of energy, applied to observations for latitude, will furnish data for getting at the geographical efficiency of the steam engine.

* * * * In Mr. Baker's lean-to there was a door, through which the fireman carried his coal. It was a very ordinary door, such as becomes the lean-to of a mill. In the front of the mill there was, as stated, a proper and becoming form of double door, out of which went the barrels of flour. Here we have another example of the inscrutable ways of the mill: a double door to let flour out, and only a single door to let coal in—and a full stroke slow motion engine at that!

* * * * Many years ago, while lots of coal was being crowded through the little door in Mr. Baker's lean-to, and while a little flour was finding exit without wire-drawing through Mr. Baker's big double door, and while Mr. Baker was making money on the operation of these doors, a young man walked out of the front door of a Northern technical college with a thesis, a sheepskin, and a title. He was an M. E., and knew about logarithms, densities, and things. He settled by a lakeside, took a sneezing fit, tore something inside of him, commenced to spit blood, was told to "drop all hard work," and journey to a sunny land to save his life. He took his indicators and density tables, and in a week became an invalid loafer in the office of Mr. Baker's southern mill. His name was McCann.

* * * * McCann had never seen the inside of a mill before, and had only seen about a dozen engines, but he gathered in books the experience of men who had seen lots of engines and mills. He was good company for Mr. Baker, and he employed himself by applying mathematical constants to the things in the mill. He counted the speed of a big pulley, and then figured how fast the little one was driven by it. Then he counted the little one, and found that things didn't agree. He kept on figuring, and may be is figuring yet.

* * * * He figured out something awful in Mr. Baker's engine room, and with blanched face he told Mr. Baker that he was using a hundred and fifty pounds of coal to the barrel of flour. Mr. Baker said he didn't care if it took a ton—he was making money.

McCann tried to contract for Mr. Baker's power, and offered to go to the expense of a lean-to and a good engine, in consideration of a yearly sum equal to present coal bills. Mr. Baker would listen to nothing of this kind; he told of many such mill outfits doing well financially, and pointed to his own case, which was entirely satisfactory; the trick of successfull milling being to buy wheat low and sell flour high.

* * * * In course of time, argument upon productive economy and a showing of facts prevailed, and Mr. Baker built a new lean-to and ordered a Hyphen-Corliss engine. The machine was set up, and McCann, to keep himself from dying of inactivity, assumed charge as engineer, a position of pride in his case, for he refused pay. He was in good circumstances; and if he should accept pay he might be charged with doing the hard work forbidden by the doctors.

* * * * After a week's run, McCann informed Baker that he was running on forty pounds of coal to the barrel of flour. Mr. Baker didn't seem to care if he was, but was proud of the engine because it was nice. McCann said he would get things into shape to do better still. Baker didn't care. He might be glad if McCann succeeded, but would not waste any unnecessary effort in getting sorry if he failed.

* * * * McCann stood by his engine like a man; kept his indicators on all the time, and got results out of the thing which would startle Hyphen himself. The forbidden work restored his health, and he went again to the lake side. Mr. Baker was sorry to see him go, for he had thoroughly appreciated the companionship of the young man. As to the changes wrought in the mill he cared nothing.

* * * * The old engineer took the new engine and liked it. As defects developed in the engine he remedied them the best he could, without much work or much knowledge. A claw block wore out in course of time, and he put a new one in. This one wore out quickly, and, to avoid the labor of replacing them, he invented a slight change in the claw device which prevented the let-go, and thus saved the blocks from all wear. From this brilliant step he was naturally led to an investigation into the governor, which seemed to be useless and in the wrong place. The miller was complaining, in a languid sort of a way, about the irregular speed. Finally, the governor of the old engine was put on the new engine, and then the speed began to behave itself.

* * * * A gentleman wrote to Mr. Baker asking for information regarding his experience with this engine. He replied that it was a very good engine, and, with some trifling changes made by the engineer, was giving perfect satisfaction. Said he did not see why it was not every bit as good as the old engine, and he knew it to be very much better looking. Said he was making money in the business.

* * * * Very respectfully,

CHORDAL.

A New Combination Tool.

As a rule, combination tools are made to the detriment of one or more of the tools represented, but the one illustrated by the engraving upon page 6 has peculiar advantages in each of the uses to which it is adapted. It is a substitute for a full set of try squares, and is more convenient, and also forms a set miter with either a long or short tongue. It may be used as a mortise gauge and scribe gauge, forming a quick and accurate way for laying out work. As a pencil-marking gauge for draughtsmen and joiners it is very successful in laying out angles of 45°. A spirit level is placed within the tool, as shown. A center head is put up with each of these tools except the smaller sizes. The scriber is held in a hole in the end of the head by a spring, and has a handle for withdrawing it.

In using this tool as a marking gauge, the head is to be set to the proper width, then by inserting a lead pencil or a scriber through the holes in the scale a gauge line may be drawn. This tool may also be used as a spirit plumb, scale, straight edge, inside and outside center square, besides a T-square and other combinations, which will readily be discovered by an inspection of the tool by the appreciative mechanic. They are furnished at a nominal price.

These tools are made by L. S. Starrett, Athol, Mass.

(*Continued from page* 1.)

The steam, having exerted its force through one stroke upon the smaller steam piston, expands upon the larger during the return stroke, and operates to drive the piston in the other direction. This is in effect the same result as using a cut off on a crank engine, except with the great advantage of uniform and steady action upon the water. This pump is especially adapted in cases where a saving of fuel is an important consideration. It is said to save from 30 to 33 per cent. of the coal required by high-pressure forms of pumps, performing the same work. Under these circumstances its greater first cost would be fully justified. On the larger sizes a condensing apparatus, either operated by the main engine or by an auxiliary one, is often added, thus securing the highest economical results. Any of the ordinary forms of Worthington steam pumps can be fitted with the compound cylinders shown in the engraving, and in proportion to suit any service. This form is already extensively applied to hydraulic elevators, tank pumps, fire pumps, mine pumps, and to engines designed for the water supply of small cities and towns. It should be borne in mind that, as the compound pumping engine uses less steam than the high-pressure pumps, their boilers may be reduced materially in size and cost compared with those required for the high-pressure form.

The principle of expansion of steam in this style of pump, without a condenser, cannot be used to advantage where the steam pressure is much below fifty pounds. The tables furnished by the manufacturer are based upon a uniform piston speed of 100 feet per minute; but this may be considerably increased in cases of emergency. The other features about this pump are well known.

It is made by Henry R. Worthington, at the Hydraulic Works, Brooklyn; office, 239 Broadway, New York.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Prest.

JACKSON BAILEY, Vice-Prest.

LYCURGUS B. MOORE, Treas. and Sec'y.

96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

LEWIS F LYNE, Mechanical Engineer.
F. F. HEMENWAY, Associate.

The American News Company,
Publishers' Agents, New York

The International News Company,
(Formerly the Wilmer & Rogers News Co.)
11 BOUVERIE STREET, (Fleet St.) LONDON, ENG
Will receive subscriptions for the AMERICAN MACHINIST at 17 shillings per annum, postage prepaid.

DEALERS SUPPLIED BY
The New York News Company, New York.
The National News Company, New York.
The New England News Company, Boston, Mass
The Central News Company, Philadelphia, Pa.
The Western News Company, Chicago, Ill.
The St. Louis Book and News Co., St. Louis, Mo
The Cincinnati News Company, Cincinnati, Ohio
The Detroit News Company, Detroit, Mich.
The Pittsburgh Book and News Co., Pittsburgh, Pa.
The Baltimore News Company, Baltimore, Md.
The Rhode Island News Co., Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The Brooklyn News Company, Brooklyn, N. Y.
The Williamsburgh News Co., Brooklyn, E. D., N.Y
The Newark News Company, Newark, N. J.
The Northern News Company, Troy, N. Y.
The Albany News Company, Albany, N. Y.
The Washington News Co., Washington, D. C.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton Branch, Clifton, Ontario, Canada.

SUBSCRIPTION.
$3.00 a year, in advance, postage prepaid in the United States and Canada.
$4.00 to Foreign Countries, postage prepaid.

ADVERTISING.
Transient, 30c. per line, (12 lines one inch.)
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, OCTOBER 22, 1881.

CONTENTS.

PAGE.
The Worthington Steam Pump—As it Was and as it Is 1
Cone Pulley Diameters. By J. F. Klein, D. E.... 2
The Thomson-Houston Dynamo-Electric Machine 3
Pumps at High Altitudes. By A. Falkenau, M. E. 3
Combination Lathe and Screw Machine..... 3
Mechanical Drawing. By Prof. John E. Sweet.. 4
Practical Steam Engine Economy. No. 2. By F. F. Hemenway..... 4
A New High Speed Engine..... 5
Letters From Practical Men—Hardening Steel in Liquids and Compounds—Efficiency of Balanced Valves—Review of Sackett's Drawing System—Bevel Seated Safety Valves—Water Power and Water Privilege; How to Compute their Power and Efficiency..... 5, 6
Extracts from Chordal's Letters..... 7
A New Combination Tool 7
The Atlanta Exposition..... 8
The New Jersey Boiler Explosion 8
Mechanical and Engineering Verbosity..... 8
Questions and Answers..... 9
Manufactures 9
Newly Incorporated Companies..... 9
Machinists' and Engineers' Supplies.. 10
Iron and Metal Review..... 10

The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

The Atlanta Exposition.

The opening of the International Cotton Exposition at Atlanta, Ga., October 5th, marks a new and advancing industrial era for the South. Hitherto the agricultural resources of the South have been regarded as its almost exclusive source of wealth, but the era of manufacturing has now developed itself to an extent warranting the holding of an immense industrial exhibition in one of its chief cities. Not only cotton manufactures have been established at the South in considerable numbers, but other branches of manufacturing have there found a profitable foothold. During the remaining weeks of this year the Atlanta Exposition will attract the people of this country, and to quite an extent the people of other countries, to a display of some of the choicest products of industrial enterprise. The exhibition will go far to allay any sectional prejudice that may remain in the minds of a portion of the people, and bring about an era of better feeling and a community of interests that has not before existed.

The Jersey City Boiler Explosion.

In the AMERICAN MACHINIST of October 1, 1881, we gave some notes of a boiler explosion which occurred on the morning of September 13th, on the dry dock in Jersey City, N. J. Since that time we have made a thorough examination of the boiler, which was of the locomotive type, and the safety valve. The total length of the boiler was 16 feet 4 inches, and diameter of cylinder part 40″. The fire box was 4½ feet long, 3 feet 5 inches wide, and 3 feet 6 inches high. There were thirty-eight tubes 3″ in diameter and ten feet long. The shell was marked C H No. 1, T. S. 50,000 lbs., Glasgow Iron Works, Glasgow, Pa.

The front end of the fire box or tube sheet, the back part of the crown sheet, and the left-hand side of the fire-box shell were fished up out of the water a few days after the explosion. The back portion of the crown sheet had four braces ½″×2″ iron, also the foot of one other brace attached to it. The sheet was not bulged between the braces, neither was the slight deposit of mud removed from the surface. The front portion which we saw about fifteen minutes after the explosion was bulged considerably between the braces, all of which were torn from the sheet. Each of the braces were held to the crown sheet by a ¾″ rivet. In separating from the crown sheet the heads of the rivets were stripped as if they had been pushed through a die while hot. The entire length of the rivets were preserved upon all the braces found; and where the heads of the rivets were stripped there were no evidences of fracturing, but the material had the appearance of iron which had been sheared while hot. There were no fractures extending from the holes in the sheet, but the latter were bulged by the rivets when being drawn through. This part of the crown sheet was perfectly clean, and did not present the same appearance as the back part. These indications, together with those given in our previous article, are convincing evidences that the front part of the crown sheet was overheated.

It is customary to set locomotive and, in fact, all horizontal boilers higher at the end farthest from the fire box, which would account for the front portion of the crown sheet only being bare. The tubes bore no evidences of overheating. They were buckled somewhat, and all of them loosened by the concussion of the dome with a tree. This concussion drove a number of the tubes almost their entire length out of the front end, and knocked the dome off.

The evidence given during the inquest proves that there was plenty of water at the time the boiler was fired up; but an excessive pressure opened some of the seams, causing water and steam to leak from the boiler some time previous to the final explosion. This would account for the crown sheet being bare, and the leaks, being in the shell, would not affect the fire, hence the crown sheet could have easily become overheated. Both ends of the fire box were bent over at the top, and the torn edges pointed downwards in a way which indicated that the crown sheet near the front end was first crushed in.

The front end of the fire box was found almost directly beneath the place it formerly occupied, and was distorted in such a way as to indicate that it occupied a neutral position between two tremendous horizontal forces, one of which fired the cylinder part of the boiler 642 feet up the street, while the other threw the furnace head of the boiler out into the river.

The left side of the fire-box shell, weighing over 200 pounds, was torn loose and thrown high in the air and fell upon the dry dock, cutting through 12″ square of timber, and after breaking the planks upon the dock, fell overboard. The cylinder part of the boiler was strongly stayed to the fire box by two braces of ½″×2½″ iron, and one ½″×2″.

We believe that there was at least 400 lbs. to 450 lbs. pressure to the square inch upon the boiler when it exploded, and it would probably take that pressure to tear the boiler to pieces as it was afterwards found. The best evidence that the boiler was well built is that it gave way all over at once, in some places at the seams, while at others the sheets were torn across as if they had been card board. There were no evidences about any of the ruptured sheets to indicate crystallization of the iron.

The most interesting specimen about the boiler was the safety valve, which was found about 50 feet up the dock, had 4 feet 7 inches of the steam pipe attached to it, the flange being broken.

The valve lever was badly bent, and the ball retained its former position, being held by a set screw upon the lever. The wrought iron stem of the valve was rusted fast in the cast iron cap upon the shell. This valve, after being examined by the coroner's jury, was placed in charge of our mechanical engineer, L. F. Lyne, who tested the same at the Stevens Institute, Hoboken, to ascertain the force required to move the valve from its seat. The center of the valve was placed upon an iron pivot, and pressure was applied upon the top of the shell. It required 3,200 lbs. to move the valve one-thirty-second of an inch. 3,700 lbs. moved it one-sixteenth of an inch, and 4,000 lbs. moved it one-fourth of an inch from the starting point, after which it was removed from the testing machine.

The cast iron cap was taken off with the valve sticking to it. An examination revealed the fact that the valve did not rest upon the seat at all, as there was a film of mud between the two surfaces. There were also indications that the valve leaked badly, and was not corroded upon its seat, moreover there were no evidences of corrosion about the valve (except the stem) or seat, both of which were of composition.

The stem of the valve was of wrought iron, rigidly attached to the valve, and fitted snugly through the hole in the cap, so that it had rusted fast, requiring the above stated pressures to move it. The lever of the valve was straightened, and the valve cleaned and put together. The weight was placed upon the lever at the point where it was found at the time of the explosion, and the valve tested by hydraulic pressure. It blew off at 65 lbs. to the square inch. The engineer said he set it by his steam gauge to blow off at 75 lbs. The ball was then moved to the end of the lever, and it was found to blow off at 100 lbs. pressure to the sq. inch. The escaping steam had to pass through a pipe 1½″ inside diameter, with an elbow in it, while the diameter of the valve was 2½″. The escape pipe should have been the same diameter as the valve. The stem of the valve was of wrought iron, but should have been of composition, and it was the only part of the valve which caused the trouble. The engineer stated in his evidence that he thought the proportion between the diameter of the valve and escape pipe correct, and did not know that an elbow in that pipe would materially affect the escape of the steam. He said that he had never seen the inside of this boiler and had run it several years. He looked on the outside for indications of broken braces and stay-bolts. He never saw a safety valve corroded to its seat, and never heard of such a thing, and swore the valve was in working order the 10th of September, or three days previous to the explosion, and blew off steam at 75 lbs. by the gauge. He said he left the boiler on the morning of the explosion with a light fire, the door open, and no steam upon the boiler. If the boiler had been left in this condition, the fire would have gone out, and no damage would have been done, The nephew of the engineer, unauthorized, went to the boiler some time afterwards, put coal on the fire, shut the door, and was ordered away about his regular duties, for he was said to have been allowed only to build the fire and sometimes start the donkey pump, but always in the presence of the engineer. This experiment of the young man resulted, as might have been expected, in a terrific explosion and loss of life and property.

The proper way to deal with boiler explosions is to prevent them, and until proper legislation is made, relating to the safety of boilers, such disasters may be reasonably expected.

Mechanical and Engineering Verbosity.

The universal verdict against what is properly termed the verbiage of the reports of mechanical and engineering tests, has, within the past few years, operated to render them practically worthless to the public. Reports which were once comprised in a couple of columns, are now-a-days spun out to fill pretentious volumes, that are never by any chance read by those who it is expected will be interested and benefited by them. Some of these volumes of well-nigh endless dissertation, sandwiched with innumerable tables, are practically unintelligible to engineers who are not directly engaged in pursuits of a kindred nature; and to such as are, they suggest any other plan for obtaining the information than reading the mass of matter that effectually envelopes the little of pertinency they contain. If these volumes are dull and unintelligible to engineers, what must they be to the body of intelligent readers who have no reasons for training themselves to observe and to understand the ways and means of expert tests, and who must comprehend forty or fifty tables, and twice as many pages of explanations, and at the same time form their conclusions?

Without for a moment seeking to impeach the correctness of the conclusions of experts, it is a fact—or, at least, it is generally accepted as such—that nearly all the special tests that have been made during the last ten years, of pumping machinery, water wheels, water motors, steam engines, etc.—tests from which it was right to expect to gain something tangible in the way of addition to our present knowledge of the subjects—have, when palpable errors did not exist in the manner of conducting them, been ruined in the manner of their telling: and where competitive trials have been entered into, the end has usually been an unseemly wrangle.

We do not refer particularly to, nor seek to make a point against, steam engine tests; although, from the nature of the case, such tests are of prominent interest. In fact, the present suggestion of the subject came from contrasting past and present practice in respect to the manner of stating facts pertaining to engineering matters, as exemplified in the report of a committee appointed some years since to examine and report upon the condition of a reservoir connected with the water supply of the city of Cincinnati. We copy the report in full from a "History of the Cincinnati Water Works," and submit it to our readers as a model in the way of brevity:

The Committee appointed to examine the reservoir of the water works from which this city is supplied with water, by Col. S. W. Davis, have performed that duty; and after a strict examination, report the reservoir to be in excellent order, the water clear and pure, and in a wholesome state.

(Signed)

_____
_____ } Committee.
_____

This report seems to have been entirely satisfactory to the citizens; and, in fact, it is

not easy to see why it should have been otherwise. It is difficult to see what was worth telling that is not told in the half-dozen lines that comprise it, and it is safe to say that it was read and comprehended by the average citizen. That committee did not evidently appreciate—perhaps they were not capable of doing so—what has come to be the modern practice, in similar instances, of establishing a datum and proceeding by giving the precise location, inclination, etc., of each particular piece, as well as its past, present and prospective history. They comprehended these details in two words. There isn't a word about analysis A, B, C, and so along through the alphabet; but the knowledge that the water was "clear and pure" seems to have been satisfactorily imparted.

Although this was not a report of a test of mechanical appliances, it may be profitably studied by those who report such tests. It is possible that in its conciseness it may indicate a means of restoring them to popular favor, or at least to a condition where some confidence will be placed in them.

Such tests are not unpopular, as is sometimes intimated, because they are made by experts. On the contrary, they should undoubtedly be made by those who are expert in that particular branch of mechanics which relates to the case in hand; but, as previously stated, they are, however carefully made, in the majority of instances spoiled in the telling. The public, in whose interest, or at least for whose information, they are popularly supposed to be made, are aware that, for instance, to arrive at the exact facts relating to the performance of a half-dozen steam engines, in such a way as to render exact justice to as many competitors, requires considerable skill, and a deal of attention to detail, but the plan of drawing out the simple recital of results in such a way as to fill an imposing volume, hiding the facts under figures and tables, the pertinency of which are beyond all finding out—at least by the ordinary intelligent reader—if it ever had any other purpose than to bring the whole proceeding into popular disrespute, is conspicuous as a failure.

The minutiæ of details that form the major part of modern engineering reports are undoubtedly of interest to a few—those who make them, for instance—but when compiled and published experience has amply demonstrated that they inspire neither awe nor reverence, and that those who ought to be benefited by them have neither the time nor the inclination to explore them.

In most of the affairs of life the habit of stating plain facts in a few plain words stands out particularly prominent as a feature of the present. Unfortunately, in this respect engineering experts, in too many instances, seem inclined to make progress backward, and it is this, rather than a lack of confidence in their abilities, that renders their reports unpopular. It would seem that a consideration of the fact that these reports were mainly made for the benefit of non-professional readers would do much to suggest the remedy.

One of the most interesting features in any successful business is to go back to the commencement, and trace its varied history up to the present time. If the business has been confined to one or two specialties, it affords the investigator much satisfaction and valuable instruction to take the original crude invention and carefully study its details, then the advances made by the addition of devices and combinations of mechanical movements, each of which, if found successful, contribute to the value of the machine or article as a whole. If the attempts at improvement do not work satisfactorily, they are abandoned. A very singular fact in connection with the development of an invention to the nearest approach to perfection is, that the first model or machine is found too complicated and composed of too great a number of pieces, whereas, with other inventions, the first one consists of too few pieces. With the former, as a rule, improvements are made by taking away some of the parts, while the latter is improved by additions to its parts. Sometimes a simple device is improved by the addition of parts until it becomes very complicated, when, by selecting a few parts and a combination or two of some of the others, the rest are thrown away, and the machine is ready for the most searching criticism.

Questions & Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) J. W. R., Brooklyn, N. Y., asks: Will you please tell me what pressure it will take in pounds to punch an inch hole through iron one inch thick? *A.* About 150,000 pounds.

(2) W. L. S., Baltimore, Md., asks: Will you please tell me how a person who has no pecuniary means, but is well versed in mathematics and a tolerably good draughtsman, should begin in order to become a good civil engineer? *A.* We know of no better way than to get some kind of a position with a civil engineer in good practice, and by hard study and strict attention work yourself up. The fact that you are a good mathematician and a fair draughtsman, is not only so much learned in the right direction, but it will help you to a position, since you will be able to make yourself useful at once.

(3) N. H. F., Dexter, Me., asks: Will you please give me a suitable process for case-hardening Bessemer machinery steel and cast iron? I find that what will work well on wrought iron will not do for steel or cast iron. I want a simple process that will not require heat to be kept up long. *A.* Machinery steel can usually be case-hardened with prussiate of potash, the same as wrought iron, except that it takes a little more time. Heat the pieces to be hardened in a coke fire, sprinkle them with prussiate of potash, reheat, and repeat the operation two or three times as you find necessary. Different grades of steel require different manipulation, and some kinds require to be heated higher than others. Sometimes it will be found to be an improvement to mix common salt with the prussiate of potash, and sometimes it is better to quench in strong brine. There is no definite plan that will be best for all kinds of steel, but by experimenting a way of hardening may be found. We do not know of any ready way of case-hardening cast iron.

(4) J. F., Providence, R. I., asks: Can I learn drawing without a teacher, and what knowledge is it necessary for a draughtsman to possess? *A.* You can learn industrial drawing without a teacher with no very serious trouble. It is not *necessary* to have a great amount of knowledge to become a draughtsman, but it is *advisable* to have all you will ever be able to get. A draughtsman who expects to rise above the level of a simple copyist, should be conversant with mechanics, and should make himself, in a general way, familiar with the various mechanical manipulations that have to do with his business—generally machine and blacksmith work, as well as foundry and pattern making practice. He should have a good knowledge of mathematics, and particularly he should be familiar with geometry. Above all, you should not be discouraged in the beginning, as you will not have to learn all these things at once.

(5) W. F. S., Carlin, Nev., writes: It is frequently necessary to put small patches on the side sheets of iron and steel fire-boxes of boilers, and where the patches are low down and where the heat is the strongest, the patches in a very short time crack from the rivet holes to the outer edge, and I have sometimes thought that a more lasting job could be made by putting on patches of copper, as it would probably not crack so quickly as steel or iron. What would be the effect of bringing copper and steel together in such a manner? By giving your views on the subject, you will much oblige a constant reader of your very valuable journal. *A.* There will be no bad effect from bringing the copper and steel together in the way you speak of, except what results from the difference in the expansion of the two metals. The inside shells of locomotive fire-boxes were formerly almost exclusively made of copper.

Business Specials.

50 cts. a line for each insertion under this head.

For Sale or Exchange, for 48" swing Engine Lathe, Canal steamer 71' x 13'. Engine and Boiler new. Wm. J. Sanderson, Syracuse, N. Y.

Patent for sale. Write, I. D. Dunning, Middletown, N. Y.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

James W. See, Consulting Engineer, Hamilton, O.

"Paragon" Metallic Piston Rod Packing. See American Machinist, July 16th, 1881. Write for prices. A. Wilkinson, Manayunk, Philadelphia, Pa.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price. $2.00, Mailed by E. & F. N. Spon. 446 Broome St., New York City, on receipt of price.

"Patent Binder" for the American Machinist holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton St., New York.

We can furnish Volume 3 of the American Machinist, containing the full 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. Unbound, three dollars. American Machinist Publishing Co., 96 Fulton Street, New York.

"Useful Information for Steam Users." Owners and managers of manufacturing establishments throughout the country, using steam power for whatever purpose, will find information of positive value in our 80-page *Illustrated Pamphlet*. This book has been carefully compiled from the best authorities in this country and in Europe, and contains interesting data on the care and management of the steam engine and boiler, and rules for engineers and firemen. The engineers of every well regulated establishment should have this work. Sent by mail on receipt of twenty-five cents in postage stamps. The J. N. Mills Publishing Co., 165 Broadway, New York.

Manufactures.

The Empire Plow Works, Allegheny, Pa., have recently put in two Bradley Cushioned hammers.

The Pittsburg Locomotive Works are said to have more than a year's orders ahead.

Mr. M. C. Jones, formerly of Troy, N.Y., is manufacturing his boiler specialties at Cohoes, N.Y.

Clem & Morse, of Philadelphia, Pa., have just shipped one of their elevators to Peru.

Romer & Vielhauer will erect a new planing mill at Tonawanda, N.Y.

The Wabash, St. Louis & Pacific Railroad are building car shops at Decatur, Ill.

At the Chicago shops of the Rock Island & Pacific Railroad, 20 locomotives a year are built.

Whitley, Fasler & Kelly, are building extensive shops at Springfield, O., for the manufacture of reapers, mowers, etc.

William Leavitt, of Philadelphia, has purchased the Delaware rolling mill at Phillipsburg, N. J., and will start it at once.

The Babcock & Wilcox Company, of New York, have the order for a battery of boilers for the Standard Machinery Company, of Mystic River, Conn.

The addition to the mower and reaper works of J. F. Sieberling, Akron, Ohio, are nearly completed.

The Morse Twist Drill and Machine Company, New Bedford, Mass., are pressed with orders for their specialties, including twist drills, chucks, reamers, cutters, etc.

The Ensign Manufacturing Company, of Huntington, W. Va., are constructing car shops. Their business has for several years been the making of car wheels.

The Straight Line Engine Co., Syracuse, N. Y., have just shipped a 55 H.P. engine to the Brush Electric Light Co., Cleveland; two to D. M. Osborne & Co., Auburn, N. Y., 40 and 55 H.P. respectively, and one to Lake Superior Iron Co. of Michigan.

A. F. Cushman, Hartford, Conn., has put in a number of additional tools, which addition has been warranted by the largely increased demand for his chucks. He is now manufacturing every class of lathe and drill chucks.

Mr. F. H. Richards, of Springfield, Mass., well-known as making a specialty of improving machines and machinery, is full of orders from all parts of the country. He is, amongst other work, making some very superior amateur printing presses for parties in Boston.

The Brown & Sharpe Manufacturing Company, Providence, R. I., since occupying their new foundry, are, in addition to their regular work, executing many outside orders for fine gray iron castings—a branch of the business which they are particularly well fitted up for doing.

The American Watch Tool Co., Waltham, Mass., are full of orders for lathes and watch-making machinery. Their lathes may be seen at the supply store of J. F. Rogers, 107 Liberty Street, New York. The bench lathe is adapted for model making, standard gauge making, hardened steel working, sewing machine shops, and for any machine shop requiring perfect work.

The Billings & Spencer Company, Hartford, Conn., are about to build a new annealing shop, in order to secure the room at present occupied in the main building by their annealing fixtures. They will use this room to locate new drop hammers and presses, a move that is demanded by their rapidly increasing business. They have just declared a quarterly dividend of $2,500.

In the new 156-page catalogue of the Pratt & Whitney Company (Hartford, Conn.), we notice in the way of new illustrations an 18" and 52" turret-head chucking machine; also a new line of turret-head engine lathes, from 13" to 21" swing; a No. 3 manufacturer's automatic feed, bench drill, 2 or 3 machines on the same table; a spur gear cutting machine; a heading machine, for heading wood screws, bolts, rivets, etc., as well as other matter not in any of their previously issued catalogues.

The Pratt & Whitney Company, Hartford, Conn., are working 675 men, and running till half-past nine o'clock five evenings in the week. They are filling foreign orders for various machine tools, including five milling machines for Mexico, and other tools for Cuba. They are also furnishing tools for two large Western sewing-machine factories, and entered an order from one company last week for 50 machines. They are putting the Parmalee Automatic Sprinkler in all their buildings. This company have just declared a semi-annual dividend of $20,000.

In reference to a recent manufacturing note, the Innis Manufacturing Co., of Oil City, Pa., write us as follows: "In your issue of October 8th, you say: 'That we have just shipped our twenty-eighth engine to the Imp. Standard Pet. Co., on the coast of the Black Sea.' We do not care to trouble you to make a correction, but wish to inform you that instead of the shipment being our twenty-eighth engine, we sent them 10 engines in their last order, ranging in numbers from 1100 up. We are making a specialty of Artesian and Oil Well Engines, of size 9x12, and are turning out a little better than two per day at present, and cannot keep up to the demand, so you see we have made considerably more than 28 engines, and have now 60 in foreign fields. Very truly yours, Innis Mfg. Co."

The Cleveland Machine Co., Cleveland, says the *Trade Review*, are introducing two new and useful machines for making and packing paper boxes, which are coming into extensive use in many lines of trade. A single box-making machine will make from 10,000 to 20,000 perfect boxes or pieces per day of ten hours, at a cost of labor varying from 15 to 25 cents per 1,000. In operating the machine, it may be said that blanks are first cut from some 40 or 50 full-size straw board sheets, of 26 by 38 inches, or any more economical size, by a cutting die used under a press. These are further cut or shaped by a nicking machine, parts being prepared in this way at the rate of from 30,000 to 50,000 a day by the machine. The blanks thus shaped are formed by the machine, pasted and completed, by a series of ingenious mechanical manipulations.

A valuable iron ore, in the form of black sand, exists in large deposits on the east beach of Block Island, and D. C. McCotter and another man from Brooklyn, N. Y., are going to use it in making steel. New processes, and a machine for separating the black sand from the silicon, have been invented, which clear 100 tons of sand in 10 hours. As the mineral ore pours out of the shutes it is placed in bags, each holding 112 pounds, and shipped to Hoboken, and thence to Rockaway, N. J. There it is loaded on wagons and afterward taken to the furnace. It is mixed with charcoal, taken by elevator into the hopper and distributed into 16 large cylinders holding about 10 tons, and heated to a red heat; then it is tapped at the bottom and let down into a large oven still kept at a red heat, and there burns out all the charcoal. The iron doors are opened, the sand is hauled out into a large charcoal fire and forms a mass which is hammered by large steam hammers into blooms, weighing from 200 to 300 pounds. Large buildings will soon be put up on the island, and, as the supply of sand is practically inexhaustible, the industry is likely to become important.—*Springfield Republican.*

Grant & Bogert, at Flushing, L. I., have got their new shop in fair shape to turn out machine tools. They have a large number of lathes and other machines partly completed. They are executing an order from the Brush Electric Light Company for a special machine for straightening brass tubing, so that it will be perfectly straight for holding carbons for the electric lights. This is a somewhat difficult operation to perform by hand, and now requires about twenty men to accomplish this work for the company named. It is intended that, with one of the new machines, a man and boy can do the same work, and in a superior manner. It was invented by a workman named Bishop, in the shop. A new milling machine is in progress, which is intended principally for making cutters for milling machines. It is calculated to mill any plane, straight or irregular surface, also angles and spirals, and can be set instantly to do this work. It will finish the cutter without taking it out of the machine. This may properly be termed a universal milling machine. The above firm have orders for two of these machines, besides numerous inquiries.

Newly Incorporated Companies.

PENNSYLVANIA.

The Hat Sweat Manufacturing Company, Philadelphia, with branch in New York City; John B. Stetson, Wm. F. Fray and John Bigelow, all of Philadelphia, corporators; Capital, $300,000. For manufacturing sweat leathers for hats and caps, materials composing the same, machines for producing sweat leathers, and hat and cap trimmings generally.

The Shenango and State Line Railroad Company; Jos. Forker, J. J. Spearman and Henry W. Horton, Jr., all of Sharon, Pa., corporators; Capital, $250,000. To build a railroad from a point on the Pittsburgh, Rochester and Sharpsville Railroad, to a point on the Pennsylvania and Ohio Canal. Length ten miles.

The Bradford and State Line Railroad Company. H. E. Collins, Pittsburgh, Pa.; and James Callery and Jas. H. Murdock, of Allegheny City, Pa., corporators. Capital, $200,000. To build a railroad from a point at the terminus of the Pittsburgh and New York Railroad, to a point on the State line between the States of Pennsylvania and New York. Length twenty miles.

NEW JERSEY.

Cold Blast Refrigerator Company, Jersey City; James Alexander, Warren A. Chase, Cyrus S. Haldeman and Edward R. Andrews, corporators; Capital, $300,000. To manufacture and sell refrigerators, to build, own, sell, lease cars, wagons, ships and storehouses for the transaction of the business of the preservation of perishable articles.

Non-Combustible Lubricating Packing Company, Elizabeth; Francis Riker, Henry Dennis, Joshua H. Martin, and others, corporators; Capital, $300,000. To manufacture and sell iron-combustible lubricating packing for axle boxes and bearings, either in the crude or prepared state, and the sale of patent rights for the same.

Hansell Car Starter Company, Camden; Charles Yard, Robert McCurdy, Joseph T. Jackson, and others, corporators; Capital, $250,000. To manufacture and sell, and to license others to manufacture and sell, an invention in car starters for railroad cars.

National Railroad Supply Company, Camden; David I. Wood, Robert Evans Peterson and Francis P. Loher, corporators; Capital, $500,000. To purchase and sell patent rights; manufacture and sell under the same, articles of metal, wood, and other material, etc.

Permutation Lock Company, Jersey City; J. L. Hubbard, George M. Hathaway and Benjamin S. Taylor, corporators; Capital, $75,000. To manufacture and sell locks, and the machinery for the manufacture of the same.

Machinists' and Engineers' Supplies.

NEW YORK, Oct 6, 1881.

The supply market continues very active, and the dealers are endeavoring in every possible way to fill their orders.

The changes in prices are few, but they have all been upward.

Manilla rope has recently advanced from 14½c. to 16c. per pound.

Forged goods, such as hammers and sledges, are obtained with the greatest difficulty. The manufacturers of these goods will furnish quotations only from day to day, for immediate delivery, and subject to change without notice.

Blacksmiths tools, also crow-bars, tamping-bars and picks, are scarce. The prices on these goods are very stiff, and an advance is probable soon.

Taps and dies are booming.

Wrought Iron Pipe continues scarce, and there was probably never such a demand in the history of the business. Some of the largest manufacturers in the country are reported as saying that they would like to be let alone for awhile. The price is stiff at 60 per cent. discount from list.

Inch pipe is the most valuable size at the present time, one dealer alone having orders for over 150,000 feet and cannot get a foot.

W. H. Hoffman, the New York manager for Kelly & Ludwig, has removed to more commodious quarters, 97 Liberty Street, where he has a full line of the Davidson noiseless steam pumps. Mr. Hoffman is also agent for water tube boilers and special furnace attachments to effect economy in fuel.

Iron and Metal Review.

Many of the manufacturers of Pig Iron are so busy that they will take no new orders except for delivery several months hence. They are working off old contracts, and such deliveries have been large during the week. The enormous consumption continues. The market is very firm, which we quote as follows: Foundry No. 1, $25; Foundry, No. 2 X, $23, and Gray Forge, $21. The market for foreign iron continues active and strong in tone. There is no Gartsherrie in the market yet. We quote: Coltness, $26; Langloan, $25; Glengarnock, $25 to $25.50; Carnbroe, $25, and Eglinton, $23.50. There is no change in Iron and Steel rails, neither in old rails. Scrap is quoted at $28 50 for No. 1 ex ship, and prime selected from yard, $30 to $31. The demand for manufactured iron is very active, particularly for bars. The price from store has been advanced to 2.8c. Copper continues at 18¼c. to 18⅝c. for Lake Superior, and Baltimore 18¼c. Straits Tin, 21⅝c. to 21¾c.; Australian, 21⅝c., and Billiton, 21¼c. Lead continues at 5¼c. to 5⅝c., according to quality. Spelter has advanced to 5⅜c. and 5½c. for Western, while Silesian remains unaltered at 5¼c. Antimony, 14c. to 14½c.

WANTED

Wanted.—A young machinist of experience to work in the tool room of a large manufacturing establishment, with a view to making for himself a permanent situation of responsibility; also wanted, a good machinist for general machine work. Parties having objection to the country need not apply. Address, Box 15, 96 Fulton Street, New York.

Mechanical draughtsman and designer, graduate of an engineering school, wishes an engagement. New York or vicinity preferred. Address, Box 2, AMERICAN MACHINIST, 96 Fulton Street, New York.

Position as Superintendent by a well-known and experienced Machinist and Designer, who is now occupying a similar position. Established reputation and first-class references. Address, SUPERINTENDENT, AMERICAN MACHINIST Office, Box 14.

A thoroughly competent and experienced steam engineer wants a situation of responsibility, with compensation corresponding to the degree of service rendered. Can furnish every required evidence of ability and reliability. Address, "Chief Engineer," office AMERICAN MACHINIST.

Wanted—Six first-class machinists used to engine work; steady job and good pay. The Hartford Engineering Co., Hartford, Conn., or 72 Astor House.

THE FIRST ANNUAL

Grand Exhibition

OF THE

NEW ENGLAND MAUFACTURERS AND MECHANICS' INSTITUTE

fully represents New England Art, Industry and resources. The Exhibition Building is a permanent structure, **the largest in the United States**, alone worth the admission fee to visit, yielding, with annexes, nearly **ten acres** of floor space, and containing Offices, Restaurants and Halls, one capable of seating over **100,000 people**. Artistic, grand, beautiful, ingenious and instructive Exhibition, rivalling in many ways the famous Centennial.

ADMISSION, 25 CENTS.

TO MANUFACTURERS AND INVENTORS.

Unequaled opportunity for the exhibition of new manufactures, machines, and inventions in New York City.

THE NEW MACHINERY HALL,

Added to the Exhibition Department of the

INVENTORS' INSTITUTE,

Cooper Union Building, New York City,

Will be ready for the reception of goods on the 15th of October, and will be opened daily from 9 A. M. to 9 P. M.

FREE TO THE PUBLIC,

As a **Permanent Exposition of Industrial Progress.** Exhibitors will be charged a moderate rental for space. **The expense will be small, the advantages great.** For space or information, address

THE INVENTORS' INSTITUTE, NEW YORK CITY.

COOKE & CO.

(Formerly Wm. Cooke, successor to Cooke & Beggs)

6 Cortlandt St., New York,

AGENTS FOR

The Lehigh Valley Emery Wheels and Emery Wheel Machinery.

Our wheels possess superior cutting qualities, combined with great durability. Eureka Plow, Polisher and Patent Stove Plate Grinders.

BOUND VOLUMES.

We can furnish Volume 3 of the AMERICAN MACHINIST, containing the fell 52 issues of 1880, neatly bound in cloth, ready to ship by express, for four dollars. Unbound, three dollars. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton St., New York.

A NEW BOOK.

Hydraulic, Steam and Hand Power Lifting and Pressing Machinery. By Frederick Colyer, M. Inst., M. E. Illustrated by 73 plates, with descriptive letter press. Price, $7.25. Send for our Catalogue of Scientific Books.

E. & F. N. SPON, 446 Broome St., N. Y.

FOR SALE

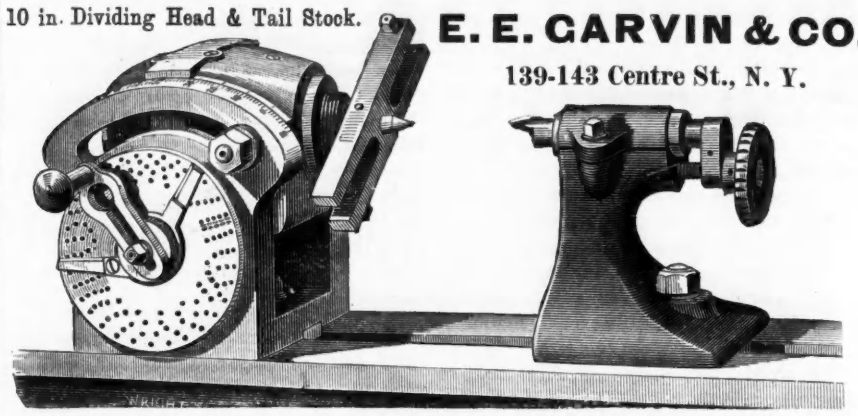
BY THE

HEWES & PHILLIPS IRON WORKS,

NEWARK, N. J.

1—100 H. P. Horizontal Automatic Cut-off Engine Cylinder, 17″x42″ new.
1—20 H. P. Horizontal Plain Slide Valve Engine Cylinder, 9″x12″ new.
2—15 H. P. Horizontal Plain Slide Valve Engine Cylinder, 6x12′ new.
1—14″x15″ Steam Air Compressor, New.
1—16x16 Belt " " "
1—Woodward Steam Fire Pump 3½ Suction.
2—1½″ discharge, 2d Hand.
1—Woodward Steam Fire Pump, 5″ Suction.
2—2½″ discharge Pipes, 2d Hand.
1—No. 1 Niagara Pump, 2d Hand.
1—Double Nut Tapping Machine, New.
1—7Foot Veneer Knife Grinding Machine, capable of grinding convex, concave or straight, very heavy and substantial and calculated for fine work.
1—Improved Car Axle Lathe.
1—57 H. P. High Speed Allen Engine.
1—70 " " " " "
1—Large Diamond Band Stone Saw to take cube 8 ft. x 5 ft. x 10 ft.
1—Large Gear Cutter to take wheel 20 ft. diameter

10 in. Dividing Head & Tail Stock.



E. E. CARVIN & CO.

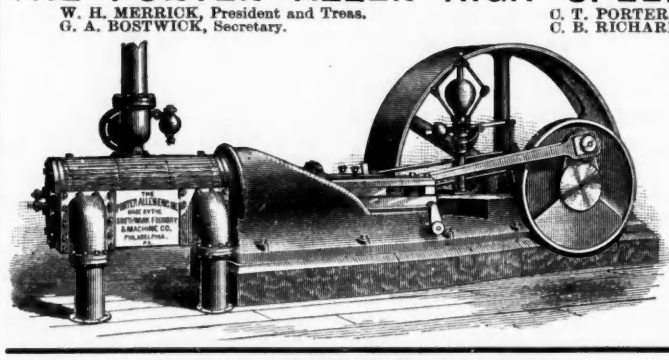
139-143 Centre St., N. Y.

This head is well adapted for use **on any milling machine or iron planer.** With it gears can be accurately spaced; mills can be cut straight, conical or irregular in form; taps and reamers can be fluted; worm wheels gashed, &c., &c. Slots in the stock allow the head to be elevated from a horizontal to a vertical position. Supplemental slots in elevating head allow the head to be depressed to 30° below a horizontal line, and 5° beyond a vertical, making 125° of change, all graduated upon the stock. Head is **rigid** in any position. Spacing worm gear is made in halves with means for compensating for wear. 3 index dials accompany the head, dividing all numbers up to 50, and as many others as an ordinary shop practice may demand.

THE PORTER-ALLEN HIGH SPEED ENGINE.

W. H. MERRICK, President and Treas.
G. A. BOSTWICK, Secretary.

C. T. PORTER, Vice-President.
C. B. RICHARDS, Superintendent.



THE SOUTHWARK FOUNDRY & MACHINE CO., Philada., having largely increased its facilities is now prepared to fill all orders for the Porter-Allen Engine on contract time.

Orders solicited for Iron and Brass Castings in the rough.

Address the Company, 430 Washington Avenue, Phila., Pa.

A. S. CAMERON'S

PATENT STEAM PUMP

IS THE

Standard of Excellence

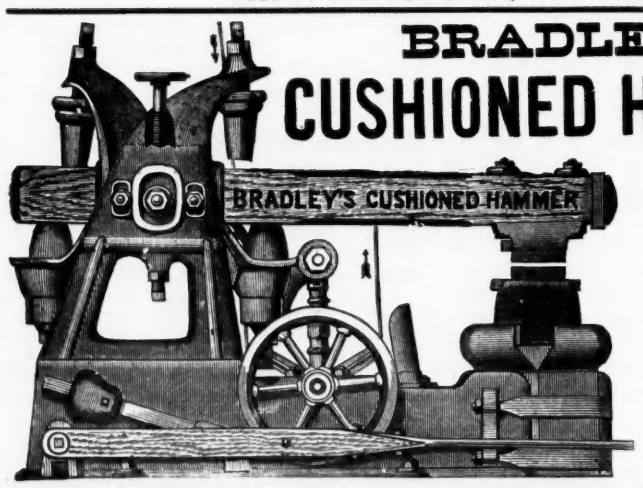
At Home and Abroad.

THE A. S. CAMERON STEAM PUMP WORKS,

Foot of East 23d Street, New York.

BRADLEY'S

CUSHIONED HAMMER



STANDS TO-DAY

WITHOUT AN EQUAL.

It approaches nearer the action of the smith's arm than any hammer in the world.

Bradley & Company,

SYRACUSE, N. Y.

[Established 1832.]

H. PRENTISS & COMPANY,

No. 42 Dey Street, New York.

P. O. BOX 3362.

DEALERS IN MACHINISTS', MANUFACTURERS' AND RAILWAY

Tools & Supplies.

KEARNEY & FOOT

FILE MANUFACTURERS,

OFFICE, 101 CHAMBERS STREET, NEW YORK.

WORKS AT PATERSON, N. J.

On every package of Files we print the following statement:

"Should a file be defective, by taking it to the party from whom purchased, a perfect one will be given in exchange free of charge."

S. ASHTON HAND,

MAKER OF

First-Class Engine Lathes,

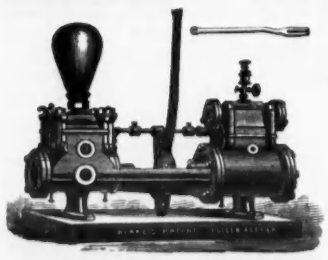
TOUGHKENAMON, CHESTER CO., PA.

Engines for Sale.

One new 14x24, slide valve. One second-hand 16x32 12x24, 12x20, 10x20, 9x16 portable, 9x14, 8x14, 6x12, and many others. A full line of good second-hand Iron and Wood Working Machinery. A complete stock of Shop and Mill Supplies. Special western agents for Knowles Steam Works, also for the Tanite Company's Emery Wheels and Grinding Machinery. Our new Steam Jet Pump is the most reliable made; send for circular.

J. H. KERRICK & CO., Indianapolis, Ind.

BLAKE'S PATENT STEAM PUMPS.



MORE THAN 13,000 IN USE.

Adapted to Every Situation.

Send for New Illustrated Catalogue.

GEO. F. BLAKE MANF'G CO.

88 Liberty Street, NEW YORK. | 44 Washington St., BOSTON.

BETTS MACHINE CO.

WILMINGTON, DEL.

Manufacturers of

MACHINE TOOLS

OF ALL KINDS.